

POTENTIAL SOCIAL IMPACTS OF HYDRAULIC FRACTURING AND SHALE GAS
DEVELOPMENT IN THE UK

by
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ABSTRACT

Hydraulic fracturing has been responsible for revolutionizing the oil and gas industry in the US, and has since gained increasing popularity as nations across the globe look for new energy sources. The United Kingdom (UK) has recently taken steps to use hydraulic fracturing to develop their own shale gas industry, although thus far the industry is still in the initial exploratory stages of development. There has been much debate over the benefits and risks that hydraulic fracturing and shale gas development pose to UK communities and this thesis will investigate the potential social impacts that hydraulic fracturing may have on communities in the UK. This thesis uses the experiences of the US to predict what may occur in the UK as the shale gas industry grows. A literature review was conducted on the current social impacts in the US and UK, as well as current regulatory regimes and mining community characteristics in each respective country. Comparisons were then drawn between each country and predictions made according to the degree of similarity between communities, regulatory processes, and current social impacts. This thesis finds that, although the growth of the shale gas industry in the UK is likely to be slower and less of a game-changer for the UK than it was in the US, communities surrounding drill sites are likely to see many of the same impacts currently experienced by shale gas communities in the US. Communities may experience the boom-bust cycle characteristic of all extraction industry growth as

well as varying degrees of social disorganization and fluctuating crime rates. This thesis also found that much of the public pushback against hydraulic fracturing and shale gas development in the UK comes as the result of environmental justice (EJ) issues. These (EJ) issues should be addressed through greater involvement of local communities in the planning and siting process for shale gas wells. This thesis concludes that due to the wide array of potential social impacts of shale gas development in the UK, greater access to data and literature on these social impacts needs to be made available to the public and local community governments. This information will be vital to the planning process and determining the local community's ability to capture benefits and mitigate risks.

Table of Contents

List of Tables.....	viii
List of Figures.....	ix
Chapter 1: Introduction	1
What is Hydraulic Fracturing?	2
Hydraulic Fracturing in the UK	4
Public Perceptions of Hydraulic Fracturing.....	6
The Need for Social Impact Literature	7
Methodology	9
Chapter 2: Hydraulic Fracturing and its Social Impacts in the US..	12
The Cycle	14
Social Impacts of the Boom.....	17
Social Disorganization.....	17
Crime Rates.....	19
Social Tension in Communities.....	21
Other Impacts.....	23
Social Impacts of the Bust.....	24
Social Disorganization.....	24
Crime Rates.....	25
Community Health.....	26
The Controllability of Boom-Bust Impacts	26
Other Impacts.....	28
Chapter 3: Current Social Impacts and Public Attitudes in the UK	30
UK Public Opinion of Shale Gas Development.....	31
Community Benefit Mechanisms	35
Monetary Compensation and Community Acceptance.....	38
Chapter 4: Hydraulic Fracturing Practices and Regulatory Regimes	
in the US and UK	41
The Scope of Hydraulic Fracturing in the US	41
US Regulation of Shale Gas Development	43
Hydraulic Fracturing in the UK	45
Available Resources.....	48
Extraction Companies.....	49
UK Regulation of Shale Gas Development.....	52
Environmental risk and water management.....	57
Rights of Property Owners.....	59

Chapter 5: Characteristics of Communities Surrounding Drill Sites	62
General Characteristics of Shale Gas Communities	62
Identified Potential Shale Gas Communities in the UK	67
Chapter 6: Environmental Justice.....	78
Environmental Justice in the UK.....	80
Implications of the EJ Movement	82
Chapter 7: Predictions.....	86
The Boom- Bust Cycle	87
Boom-Bust Cycles in the UK.....	89
Social Impacts of the Boom Cycle.....	94
Social disruption.....	94
Crime rates.....	97
Social tensions.....	98
Other boom cycle impacts.....	103
Social Impacts of the Bust Cycle	104
Possible Boom-Bust Impacts on Identified UK Shale Gas Communities.....	106
Chapter 8: Conclusion.....	110
List of References:.....	117
APPENDIX.....	126

List of Tables

TABLE 2.1 List of the Major Impacts of Hydraulic Fracturing.....	14
TABLE 5.1 Identified Shale Gas Communities in the UK.....	68

List of Figures

Figure 1.1 Hydraulic Fracturing and Shale gas extraction.	4
Figure 3.1 Percieved Risks of Hydrualic Fracuring	32
Figure 3.2 Public support for exploratory activity in the UK.	34
Figure 4.1 Total UK offshore oil production	47
Figure 4.2 Total UK natural gas production, import, and export.....	47
Figure 4.3 UK shale gas basins.....	49
Figure 4.5 UK regulatory process for shale gas well development.....	56
Figure 5.1 Shale gas community locator map.	69
Figure 5.2 Elswick map.	71
Figure 5.3 Blackpool map	72
Figure 5.5 Ellesmere Port map	75
Figure 5.6 Kirby Misperton map	76
Figure 7.1 Boom- Bust cycle pattern.....	89
Figure 8.1 UK Public support for shale gas exploration in light of regulation.....	113
Figure 9.1 Shale gaw well structure.	127

Chapter 1

Introduction

Hydraulic fracturing has been responsible for revolutionizing the oil and gas industry in the US, and has since gained increasing popularity as nations across the globe look for new energy sources. The practice has been a focus of much public debate in recent decades due to its many controversial benefits and risks to the public, the environment, and industry workers. The United Kingdom (UK) has recently taken steps to use hydraulic fracturing to develop their own shale gas industry, although thus far the industry is still in the initial exploratory stages of development. This exploratory activity has brought the debate over the safety and acceptability of hydraulic fracturing to the forefront of UK public and government attention (Hays et al, 2015). This thesis will explore the development of the UK shale gas industry as a means of assessing the potential social impacts hydraulic fracturing may have on communities in the UK.

To date, there is extensive literature on the environmental risks and benefits associated with hydraulic fracturing and shale gas production. There is also extensive literature on the economic implications of shale gas production. The social impacts of hydraulic fracturing and its resulting shale gas industry boom have only recently become the topic of a growing array of research and publications. However,

this literature pertains largely to the US and little to no published research exists on the potential social impacts of this industry's growth in the UK. This is largely due to the infant nature of the UK hydraulic fracturing industry, which has not yet grown to the point of having notable impacts on communities, nor has it been in operation long enough for its effects to be thoroughly assessed. For this reason, this thesis draws considerably from information about hydraulic fracturing in the US, which has a much more extensive history in dealing with hydraulic fracturing and its impacts. Information on the US hydraulic fracturing industry and its effects on communities will serve as a guide for determining the possible effects of the industry on UK communities.

What is Hydraulic Fracturing?

Hydraulic fracturing is a process used to extract oil or natural gas by injecting high-pressure fluids into the rock below the surface of the earth. This paper will focus solely on the extraction of gas through hydraulic fracturing as the UK is focused on the development of shale gas rather than shale oil. Throughout this paper hydraulic fracturing will repeatedly be referred to as "fracking," a common term used to distinguish the practice. Fracking fluids, which are approximately 99% water and 1% chemical additives, are used to create a crack, or fracture, in the underground rock. This fracture is then propped open with injected sand to allow for the flow of natural gas from pockets within the rock to the earth's surface through a well. When it reaches the surface, the gas is then captured and stored in tanks for future use (Ladd, 2013; Schafft, Glenna, Green & Borlu, 2014; Wang, Chen,

Jha, Rogers, 2014). The type of gas extracted through this process is called unconventional gas. Unconventional oil and gas cannot be feasibly extracted through conventional drilling techniques, meaning they cannot be produced in an economical manner without the use of hydraulic fracturing (Schafft, Glenna, Green & Borlu, 2014; Wang, Chen, Jha, Rogers, 2014). Thus, hydraulic fracturing has become synonymous with the shale oil and gas industry as the industry would not exist as it does today without this drilling technique.

In the unconventional oil and gas industry fracking is typically used in combination with horizontal wells in order to maximize the productivity of a single well site. Horizontal drilling allows extraction companies to drill vertically into the subsurface to a certain depth, then turn the well to reach horizontally across the land (Gopalakrishnan & Klaiber, 2013). This works much like a tree root, with each horizontal offshoot spreading out across the subsurface and increasing the area from which a single, vertical well may extract resources. Figure 1.1 below outline the fracking and extraction process for a typical shale gas well. Not only does horizontal drilling increase well productivity, but it also cuts down on the number of well pads that must be constructed on the land's surface. It should be noted, though, that drilling cannot occur simply anywhere; it is limited to regions possessing shale rock formations. This is because only shale formations possess the geological properties necessary to produce shale oil and gas. The combination of improved hydraulic fracturing techniques and the use of horizontal well bores revolutionized the gas industry in the US, and has since gained popularity amongst nations across

the globe (Gopalakrishnan & Klaiber, 2013; Popkin, Duke, Borchers, & Ilvento, 2013; Wang, Chen, Jha, Rogers, 2014).

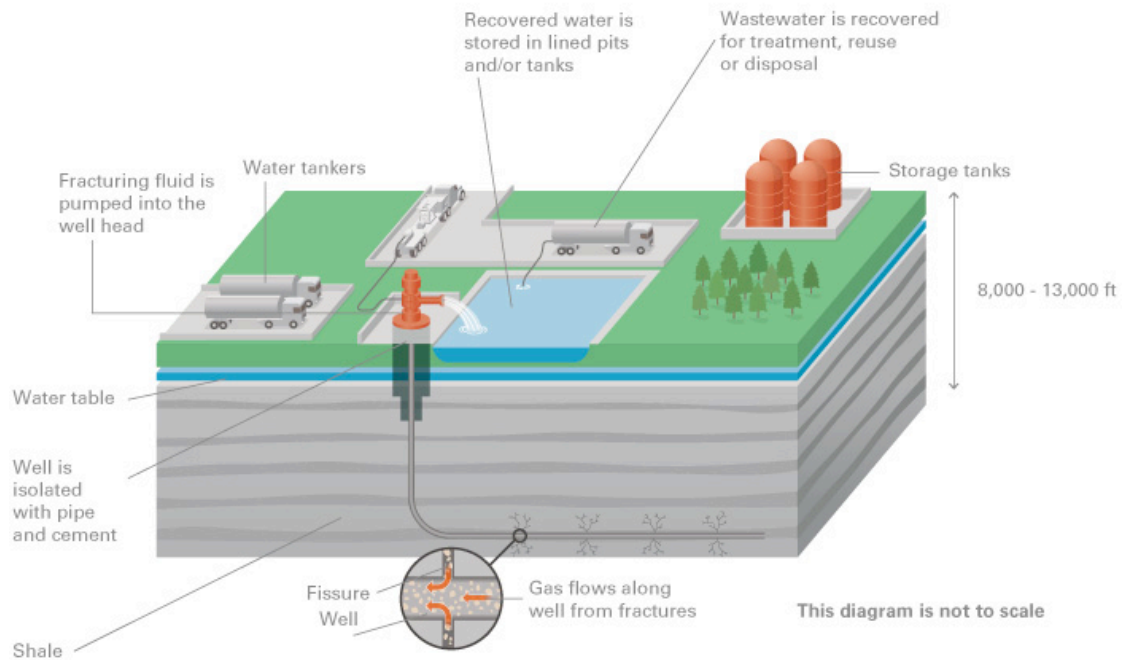


Figure 1.1 Hydraulic Fracturing and Shale gas extraction. Displays a typical shale gas well that has been hydraulically fractured and outlines the various procedures involved in gas extraction (BP p.l.c. 2015).

Hydraulic Fracturing in the UK

The UK oil and gas industry has used hydraulic fracturing on a small scale for the commercial production of oil since the late 1970s, with approximately 200 wells having been fracked to date. This number represents approximately 10% of the total wells drilled during this period (The Royal Society & The Royal Academy of Engineers, 2012). Although data on the social impacts of these existing hydraulically fractured oil wells would be useful in predicting the potential impacts of hydraulically fractured gas wells, no such data is available at the time of this writing.

In regards to the production of shale gas, fracking has only been used to drill a handful of exploratory wells to date. The national debate over the acceptability of hydraulic fracturing in the UK has been ongoing since the first signs of fracking-induced seismic activity in 2011 caused government to impose a year-long moratorium on shale gas activity. In order to determine whether hydraulic fracturing can be carried out in a manner deemed safe for UK communities, the national government used this period of industry inactivity to sponsor studies on the drilling technique and its possible effects on the environment and public health. The studies ultimately concluded that fracking is safe when carried out according to industry best practices, and the government lifted the moratorium in 2012. Despite this, no further fracking activity has taken place to date and shale gas development continues to be all but stagnant. This inactivity is expected to change in the near future, though, as the UK government recently concluded its 14th round of onshore licensing for oil and gas extraction operations. This licensing round brought the number of planned shale gas exploratory well sites up to a total of eleven, nine of which have been proposed as future fracking sites (Vaughan, 2015). This small number of possible fracking sites underscores the fact that fracking for shale gas in the UK is currently not widespread and has not yet been accepted as common industry practice.

The UK government remains hopeful about shale gas development and has made significant efforts toward promoting industry growth. Prime Minister David Cameron has announced that the UK is “going all out for shale,” making it evident that and the government is not debating IF shale gas development will occur, but

WHEN (Shale Gas Europe, 2014). This government commitment makes the future establishment of a commercial shale gas industry all but guaranteed provided that exploratory operations uncover adequate resources to ensure the economic feasibility of the industry. Although, it is important to note that government and industry alike admit that the pace and scale of development is increasingly dependent upon the ability of the industry to gain public acceptance. The current snail-paced growth of shale gas development is largely due to public skepticism about hydraulic fracturing and pushback from local interest groups who believe risks outweigh benefits. The need for support from local communities has become paramount as government and industry recognize that without public acceptance, industry growth will continue to be slow and full of roadblocks (EAC, 2014).

Public Perceptions of Hydraulic Fracturing

Despite numerous government and industry sponsored studies and reports concluding the practice is safe, outlining best practice procedures to minimize the risks posed by industry activity, and reassuring community residents that the benefits of shale gas production far outweigh the risks associated with it; the public still proves skeptical and divided over the safety of shale gas development through the use of fracking (EAC, 2014). The divide between industry support and opposition is clear through the media as industry, often supported by national government, espouses one side of the argument while public interest groups and local government espouse another. At the time of this writing the lines between parties are most clearly drawn in Scotland, where a moratorium on all shale oil and

gas activity was implemented by the Parliament at Holyrood in January 2015 (Brooks, 2015). The halt on activity comes as the result of strong opposition to fracking practices from the Scottish public.

Interest groups from both sides of the argument are taking advantage of the opportunity to provide evidence to parliament in support of their claims in order to assist the government in making an informed decision on whether or not a permanent fracking ban is necessary. Opposition groups warn of dangers such as earthquakes, water contamination, and plummeting property values for those living near well sites. Pro-shale gas development groups promote the benefits of industry development such as economic growth, job creation, and cheaper domestic gas prices for the public. They also warn that the declining productivity of the North Sea oil industry could have significantly damaging impacts on many local industries and the national economy unless domestic shale gas production is developed to help mitigate the negative impacts of transitioning from offshore oil to other energy sources (Dickie, 2015; INEOS, 2015b). These arguments are not specific to Scotland, but have been presented across the UK as shale gas exploratory activity is carried out.

The Need for Social Impact Literature

Communities and local governments have recognized the importance of their decision to accept or reject shale industry activity, and have shown a desire for greater information regarding the potential implications of a decision to approve these operations. Without a proper understanding of the potential effects that

increased fracking could have in the UK, it will be impossible for government and citizens to make informed decisions about the development and regulation of the shale gas industry. This study is an attempt to answer the question of what are the potential social impacts of hydraulic fracturing on communities surrounding drill sites in the UK. The ability to predict the social impacts fracking may have on UK communities is important for determining how to best proceed with the development of a shale gas industry and how to properly regulate it in order to mitigate harm to local residents. The information in this study is, therefore, highly relevant to the current decision-making of government and municipalities in the UK as they move from exploratory drilling toward commercial production of shale gas and oil.

The UK government claims to have conducted substantial research on the social impacts that the industry could have on local communities, but the published draft of the resulting report has large portions of the description and explanation of these impacts redacted. The report is titled *Shale Gas: Rural Economy Impacts* and was published by the Department for Environment, Food & Rural Affairs (DEFRA) in 2014. This incomplete publication caused much public discontent and produced widespread calls for the release of an unadulterated version of the report from the public and Members of Parliament (MPs) alike (Mason, 2014; Spencer, 2014). This reaction to the government's unwillingness to disclose information on the possible impacts of fracking on local communities demonstrates that there is a significant desire amongst the public for information regarding these impacts.

The fact that the UK government declined to release an un-redacted version of their report and that little other research has been conducted into the matter means that UK communities are largely uninformed about the social impacts that shale gas development could have on their region. This information void leaves communities incapable of making educated decisions, as they are unable to take all factors of the situation into consideration when deliberating the pros and cons of shale gas extraction activity within their locality. The need for more publicly accessible information on the potential social impacts of shale gas industry development on communities in the UK is pressing; this thesis is an attempt to take a small step toward satisfying this need and shrinking the present information void (Mason, 2014; Spencer, 2014).

Methodology

This study analyzes existing literature concerning the hydraulic fracturing practices and regulating policies of the US and the UK, along with the social impacts these practices have on communities in close proximity to drill sites. An extensive literature review was conducted to collect data and information on the current social impacts of fracking in the US and projected impacts in the UK, along with the current shale gas extraction processes and regulations in place in each respective country. The literature examined consists of articles, reports, studies, and legislation from a myriad of sources including peer-reviewed academic journals, trade journals, government organizations, think tanks, newspapers, and industry organizations. Much of this literature pertains to hydraulic fracturing in the US due

to the lack of information available on hydraulic fracturing and its social impacts in the UK.

The data collected through this review was then analyzed and the past and present industry practices, as well as the social impacts associated with these practices, are compared between the UK and US. The characteristics of extraction communities in each respective country are then analyzed and compared as well. These comparisons are made in order to determine how similarly situated communities of each country are as the more similarly situated communities are, the more likely they are to experience similar impacts. A prediction is then made about the level of similarity that can be expected in the social impacts of hydraulic fracturing based on the level of similarity found between the characteristics of communities, industry operations, and government regulations on extraction activity. Both a general prediction of how UK communities may be positively and negatively affected and individualized predictions for specific UK municipalities are given. The predictions for individual municipalities are based on information gathered about current communities surrounding UK shale gas exploratory sites and the experiences of other UK municipalities dependent upon the oil extraction industry.

This study does not attempt to answer questions about the overall economic impacts of fracking for the UK as a whole, although it does consider the economic effects on local communities and individuals where they pertain to social impacts. This paper also does not consider whether or how a boom in the shale resource extraction industry may benefit individuals indirectly through a boost to the

national economy. The potential environmental hazards of fracking in the UK will also not be a major focus of this paper as there is already much research available pertaining to this aspect of shale gas development. This paper does not seek to determine the potential success of a UK shale oil and gas industry, nor does it seek to draw a comparison between the potential productivity of US and UK resource extraction industries. It aims solely to determine what social impacts UK communities may see in the future due to a shale gas industry boom.

Chapter 2

Hydraulic Fracturing and its Social Impacts in the US

Hydraulic fracturing and its social impacts in the US reveal potential effects that could occur in the UK from a growing onshore gas industry utilizing hydraulic fracturing. Chief among these is the boom-bust cycle associated with resource mining towns and regions across the country (Christopherson & Rightor, 2011; Schafft, Glenna, Green, & Borlu, 2014). These boom-bust regions include the Marcellus Shale play of the northeast, which was previously prime coal country for America, and the Bakken Shale Play of North Dakota, which is currently experiencing a boom in the shale oil industry. These are two regions that will be mentioned throughout this thesis due to the extensive availability of information and research conducted on the impacts of industry in these regions. Many of the small, rural, and typically poor towns of these regions are well acquainted with the boom associated with the significant growth of a resource extraction industry, although today that industry is shale oil and gas rather than traditional coal and oil. Much of the literature on boomtown effects in the US focuses on the coal industry as well as the oil and gas industry. The similarities between the boom-bust cycles induced by these industries are considerable as both are components of the resource extraction industry. Studies have found that the specific type of mining matters little in regards to its effects on the community, as the impacts of resource

mining are typically the same across the industry (Deller and Schreiber, 2012; Weber, Geigle, & Barkdull, 2014). Therefore, this chapter examines many of the historical effects of coal mining booms and busts along with the current effects of the shale gas boom.

This chapter also explores the components of the boom-bust cycle in the US and the social impacts that are associated with it. Many social issues such as social disorganization, rising crime rates, and increased social tension in communities are aggravated by the more direct effects of the boom-bust cycle. This chapter looks at how these social issues play out during both the boom and the bust. It also explores other social impacts that may not be linked to the boom-bust cycle. Table 2.1 below provides a brief overview of each of the major social impacts explored in this chapter.

TABLE 2.1 List of the Major Impacts of Hydraulic Fracturing to be discussed in this thesis and a brief description of each.

Boom- Bust Cycle	The rise of the extraction industry can create a boomtown effect in local towns where the local economy grows substantially during periods of industry productivity. Localities see sudden population growth and growth of service sector business. When industry production falls and eventually leaves the region there is a sudden bust cycle where the local economy collapses and population plummets. The town is often left in poorer condition than before the extraction industry entered the region (Christopherson & Rightor, 2011; Weber, Geigle, & Barkdull, 2014).
Social Disruption	Seen during the boom-bust cycle due to industry activity and its resulting rapid population changes, which lead to a loss of community norms. This may include the loss of community social networks, residential instability, decreased efficiency in community services, and a loss of family norms (Luthra, Bankston, & Kalich, 2007; Shandro et al, 2011; Weber, Geigle, & Barkdull, 2014).
Fluctuating Crime Rates	Crime is closely linked to social disorganization and community norms. As social disruption takes place due to industry activity, crime may increase or decrease depending on the size and composition of the community (Kaylen & Pridemore, 2013; Luthra, Bankston, & Kalich, 2007).
Social Tensions	Results from the polarization of opinions over fracking activity in the community. The difference in distribution of benefits and risks to local residents often causes increased social tensions in the community. In the US these typically arise between landowners and non-landowners due to the distribution of lease and royalty payments (Apple, 2014; Jacquet, 2012; Lipscomb, Wang, Kilpatrick, 2012).

The Cycle

During a boom cycle, the sudden influx of jobs and capital into a municipality in association with the rapid growth of the extraction industry can create competition that pushes out more sustainable industries and creates a loss of more stable, long-term jobs. This loss of diversity in the business sector leaves the town even more susceptible to the risks associated with the mining activity by making it highly dependent on the extraction industry (Deller & Schreiber, 2012). There is a

temporary increase in spending in the region as more jobs and workers enter the area, which leads to the growth of the service sector and those businesses needed to support the local population (Christopherson & Rightor, 2011). This typically includes restaurants, hotels, retail stores, banks, and other non-extraction businesses. The overdependence on the mining industry that develops as the municipality morphs into a company dominated boomtown sets the municipality up for a detrimental bust once the mining industry declines and leaves.

During the boom there is typically a significant in-migration of industry workers who maintain a permanent residence elsewhere, but travel with the company between drill sites and need short-term housing within the local community. The influx of migrant workers can raise rent prices through increased demand for a limited supply of housing, which can force some of the local tenants to leave the area and yield their residences to the migrant population (Christopherson & Rightor, 2011; Lipscomb, Wang, & Kilpatrick, 2012). The lack of housing created by a rapid expansion in population size can lead to substandard living conditions, price gouging, over-crowded *man camps*¹ for migrant workers, and an increase in homelessness. This housing crisis tends to disproportionately impact the most vulnerable in the community, particularly those on fixed incomes (Schafft, Glenna, Green, & Borlu, 2014; Weber, Geigle, & Barkdull, 2014).

¹ A *man camp* is a form of temporary housing set up for oil and gas industry workers near a drill site. The type of housing provided here can range from a barracks-style temporary camp to traditional lodge-style accommodations. The camp is essentially a self-sustaining community providing food and laundry services, as well as recreational facilities for workers (Lyons, Vorys, Sater, Seymour and Pease LLP, 2013).

Communities that have experienced boom-bust cycles in the past are generally more prone to experiencing these types of housing shortages due to their reluctance to build additional infrastructure to accommodate a growing population (Weber, Geigle, & Barkdull, 2014). After having seen the detrimental effects of a bust in the past, a town is typically more reluctant to invest in new infrastructure such as housing because those who remember the previous bust know that most new accommodations will be unnecessary when the population drops again in a few years time (Christopherson & Rightor, 2011). In order to protect themselves from future loss or harm during the impending bust cycle, the citizens and local government of these towns typically choose to invest as little as possible in growing the municipality during the boom cycle.

As gas and oil are limited resources, it is inevitable that at some point the resources will be extracted and the industry will be forced to leave the region in favor of a more productive site. In a bust, there is no other industry or significant business sector left to support the town because all non-extraction based industries were crowded out during the boom. As a result, the town sees a sudden loss of funds and business as the service sector built up to support the booming extraction industry is no longer sustainable (Apple, 2014; Christopherson & Rightor, 2011). The migrant workers move out, along with others who can no longer make a viable living in the region and the population plummets. Revenue shrinks dramatically and the local economy typically becomes poorer than it was before the extraction industry moved in (Christopherson and Rightor, 2011; Deller & Schreiber, 2012; Weber, Geigle, & Barkdull, 2014). The physical infrastructure built to accommodate

the boomtown population is then left for a much smaller, poorer population to maintain (Christopherson and Richter, 2011).

Social Impacts of the Boom

The use of hydraulic fracturing in commercial production of shale gas in the UK could cause a boom in the extraction industry. Towns surrounding drill sites or closely linked to the resource extraction industry may, in turn, experience a boom cycle. In order to determine what effects communities in the UK may experience during a future boom, it is useful to examine the effects already being seen during boom cycles in the US. The characteristic effects of a boom cycle, such as economic development, rapidly changing population, and the lack of adequate housing, tend to have significant effects on social norms within the community. This paper will look at three major social impacts of boom cycles induced by the introduction of resource mining industries into towns. These impacts include social disruption, changing crime rates, and social tensions within the community.

Social Disorganization.

The first major social impact of the boom cycle is the social disorganization it can create within a community. Social disorganization theory states that rapid growth within a municipality leads to the loss of community norms, decreased effectiveness of community services, and ultimately crisis within the community (Luthra, Bankston, & Kalich, 2007; Weber, Geigle, & Barkdull, 2014). This essentially creates disruption within the community and much of the existing literature on this social impact uses the term social disruption to refer to the various results of social

disorganization, such as crime, drug usage, and family disruption. The term social disruption in this thesis will be used to refer to the loss of community social networks, changes in the socio-economic status of the community and changes in community services. The loss of community norms is often the most visible component of disorganization as it is hard to overlook the rapid growth in population, business, and sometimes even in infrastructure that occurs during the boom. These changes can alter the traditional demographics and socio-economic status of the community, as well as create residential instability (Kaylen & Pridemore, 2013). As the extraction industry grows, many residential areas take on a more commercial nature as property owners sell land and sign leases to the drilling companies. This can contribute to the loss of community norms as families and residents find themselves living in a more industrial neighborhood (Radow, 2014).

Rapidly shifting population is another major contributor to the loss of community norms. The in-migration of migrant workers tends to be seen negatively by permanent residents of the community and can have various effects on the social structure and demographics of the community (Christopherson & Rightor, 2011; Ladd, 2013). A survey of towns in the Pennsylvania Marcellus Shale region shows that many permanent residents view temporary workers as a burden on the local public service system. The workers are not residents of the town, so they often pay no local taxes to support the services of which they take advantage while they stay and work in the locality (Schafft, Glenna, Green, & Borlu, 2014). As previously noted, the influx of workers also contributes to the housing shortage during a boom,

pushing more permanent members of the community out and replacing them with temporary residents. This residential instability adds to the social disruption as community social networks begin to change and neighborhood dynamics are altered (Kaylen & Pridemore, 2013; Luthra, Bankston, & Kalich, 2007).

Decreased effectiveness of community services occurs during the boom largely because of the added strain that boomtown conditions place on local service providers. The increase in population raises public service costs for the town, as greater services are needed to support a larger community (Christopherson & Rightor, 2011; Schafft, Glenna, Green, & Borlu, 2014; Weber, Geigle, & Barkdull, 2014). It becomes more difficult for social service workers to operate efficiently during the boom period as insufficient funding, lack of affordable housing and child care, and increased traffic all make it more challenging for workers to serve clients in the boomtown area (Weber, Geigle, & Barkdull, 2014). A lack of social workers and service providers in general often exacerbates the problem, as the service sector cannot grow fast enough to keep up with community needs (Shandro et al, 2011; Weber, Geigle, & Barkdull, 2014).

Crime Rates.

Growing levels of social disorganization are often associated with increased crime rates in communities. The direct effects of social disorganization include poverty, greater ethnic diversity, increased residential instability, and family disruption, which indirectly lead to increased crime rates (Kaylen & Pridemore, 2013). This being said, it is important to note the difficulty in linking crime rates directly with the activity level of the resource extraction industry. Crime rates,

particularly homicides and suicides, tend to fluctuate substantially in small towns, which makes it difficult to tie the variations with changes in industry activity. External factors other than the presence of the resource extraction industry must also be considered when analyzing fluctuations in crime rate. The expected rise in crime rates due to a boom in the extraction industry can also not be standardized across municipalities as the manner in which crime levels change during a boom depends largely upon the size and composition of the specific municipality (Luthra, Bankston, & Kalich, 2007).

A study on crime rates in rural communities in the UK revealed that social disorganization is most significantly linked to property crimes and may perhaps be linked to the level of violent crimes in an area depending on the composition of the community (Kaylen & Pridemore, 2013). The study shows that communities with increased mining activity may see increased property crimes due to the social disorganization that industry activity creates, but the community may also experience a decrease in certain types of violent crimes. This trend is also seen in US mining communities. A study on communities in the coastal region of Louisiana revealed that increased mining employment in a parish was negatively associated with homicide and aggravated assault. This means that as mining employment increased in the community, the number of homicides and assaults decreased. The study also showed that as population size grew in a parish, the rates of burglary, larceny, and robbery increased, exhibiting a positive link to drilling activity (Luthra, Bankston, & Kalich, 2007).

The rapidly changing population and the residential instability created by the boom can also create a loss of community cohesion and social networks in the municipality (Luthra, Bankston, & Kalich, 2007; Witter et al, 2013). Friendship networks are important to the safety and cohesion of the community because the more dense the social network is, the more likely neighbors are to hold each other accountable for their actions and to step in to protect each other from victimization (Kaylen & Pridemore, 2013). This high level of guardianship in the community is an informal control by which residents may keep crime levels down (Luthra, Bankston, & Kalich, 2007). Shrinking social networks due to rapidly changing population make it harder for residents to identify strangers or to know when something is out of place in their neighborhood. This limits residents' ability to identify threats and take action on each other's behalf to promote the safety of their community (Kaylen & Pridemore, 2013). A lack of friendship networks can ultimately lead to an increased fear of crime or even an increase in crime itself within the community (Luthra, Bankston, & Kalich, 2007).

Social Tension in Communities.

Social tension often arises in the community due to differing opinions and polarization over the issue of mining activity and to what extent resource mining should be allowed within the region. The social costs of mining activity are typically born by the community as a whole, but are most noticeable to those members who do not receive any of the direct benefits of this activity (Apple, 2014). The divide between those benefitting from the presence of the mining industry and those who are not tends to be drawn between landowners and non-landowners. This can

create a sort of haves vs. have-nots division in the community, with landowners who have both surface and mineral rights to their property benefitting the most (Apple, 2014; Jacquet, 2012; Lipscomb, Wang, Kilpatrick, 2012).

Members of the community who believe the mining will provide substantial benefits typically believe it will bring in large lease and royalty payments, higher local rents, increased property values as demand for land rises, and increased revenue for local government services. Members who believe the mining activity will harm the community typically believe it will cause air and water pollution, increase noise, dust, and truck traffic in the region, cause demographic changes that will overburden the local government services, ultimately reduce property values, and degrade the character of the community through industrialization or demographic changes (Apple, 2014; Ladd, 2013). It is important to note that the perceived negative effects are things that will impact all community members regardless of their involvement in the resource extraction industry while the perceived gains, on the other hand, will largely only benefit those who own land, mineral rights, or property. This highlights one of the main reasons that those who are not receiving direct benefits from resource extraction often have negative views of the industry: they suffer all of the inconveniences and risk of harm to the community without gaining any of the benefits. This is the main cause of discourse between the haves and have-nots of boomtown communities. The distribution of positive and negative impacts is not even throughout communities, so while many may incur the costs only few will reap the rewards (Popkin, Duke, Borchers, & Ilvento, 2013).

A study conducted in the Marcellus Shale region found that average lease payments to land owners by resource extraction companies is about \$6,000 and the average royalty payment is around 20% (Gopalakrishnan & Klaiber, 2013). This gives property owners substantial incentive to support resource extraction activities. Those who are adversely effected by the resource boom and who are in opposition to the extraction industry operating within their municipality often become seen as spoilers by those who are receiving direct benefits and monetary gain due to the presence of the extraction industry (Radow Esq., 2014). This split in the community can lead to divisiveness in local governance and, therefore, decrease the community's bargaining power in relation to the extraction industry. If a large or highly influential portion of the community is receiving benefits from the extraction industry, it becomes more difficult for local government to oppose the operations of the industry and to mitigate any negative impacts on the municipality (Apple, 2014).

Other Impacts.

There are some economic benefits seen by municipalities during the boom period in addition to the potential social impacts, largely due to the growth of the local economy. The growth of supporting service industries during the resource boom creates an increase in the number of employment opportunities available in the region surrounding the drill site. These jobs are typically short-term, part-time positions in trucking, retail, and construction (Christopherson and Rightor, 2011). Employment rates tend to rise during the boom period as well as median incomes. As economic development increases, the need for traditional social welfare and cash assistance programs typically declines (Weber, Geigle, & Barkdull, 2014). This can

place communities in an economically better off situation during the boom cycle than they have previously experienced without local resource extraction activity.

Social Impacts of the Bust

The bust cycle and its effects are often more long-term than the short-lived boom cycle and its impacts (Christopherson & Rightor, 2011). As the extraction industry and its worker population leave the region, the supporting businesses begin to leave as well. There is an increase in unemployment and studies have found that job markets are often worse after a bust cycle than before mining operations even began (Deller & Schreiber, 2012). This sudden loss of services and employment opportunities puts significant strain on communities and often results in higher poverty rates, lower median incomes, and poorer health conditions for residents (Weber, Geigle, & Barkdull, 2014). This can lead to social disruption, a rise in crime rates, and a decrease in overall community health.

Social Disorganization.

Social disorganization during the bust manifests itself in many of the same ways as it does during the boom with the difference being that during a bust the disorganization is due largely to an exodus of residents and businesses rather than rapid growth. After the initial boom within the community there is typically a short period of stability where growth and resource production level off. This gives the community time to adjust to the “new normal” of their boomtown status and establish new routines and social networks. This period is usually cut off rather rapidly, though, as production declines and the industry begins to move out

(Christopherson & Rightor, 2011). There is a loss of social networks and community cohesiveness as those with the means to move to a more economically stable region do. This continued residential instability can further disrupt community norms as neighborhoods struggle to maintain a healthy population. The loss of community norms is often followed by a loss of family norms during the bust. High levels of stress put on families during the bust period have been seen to result in increased levels of divorce and domestic violence within communities. Many men and women have to take on long commutes in order to find new work when businesses leave the region, which adds to family dysfunction (Shandro et al, 2011).

Crime Rates.

Communities have typically been found to have an even lower economic status during a bust cycle than they possessed before the resource extraction industry even entered the region (Christopherson & Rightor, 2011). This can lead to lower socio-economic status within the community through increased poverty levels as those members of the community with the means to move elsewhere often do. Low socio-economic status is often associated with higher crime rates as it leaves the community with less informal and formal controls to regulate the behavior of those within the community (Kaylen & Pridemore, 2013; Luthra, Bankston, & Kalich, 2007). As many people begin to migrate out of the now economically faltering municipality, there is again a loss of social networks and neighborly bonds. Neighbors become less willing to intervene on each other's behalf to promote the common good, and thus criminal activity is allowed to grow (Kaylen & Pridemore, 2013).

The aforementioned study on the communities of Louisiana revealed that as poverty levels increased, rates of larceny and assault actually decreased. This is possibly due to the fact that as people and businesses migrate out of the area leaving a much more economically deprived population there are simply less people to steal from and less covetable wealth to be stolen (Luthra, Bankston, & Kalich, 2007). Increased poverty and low socio-economic status are also associated with family disruption, which can lead to increased levels of delinquency among minors (Kaylen & Pridemore, 2013).

Community Health.

The stress placed on the community as resources, jobs, and services leave the region and residents are left to deal with the long-term impacts of the drilling industry can lead to a decrease in the overall health of the community (Weber, Geigle, & Barkdull, 2014). Increased drug abuse is often seen during the bust cycle along with higher rates of alcoholism, depression, and anxiety (Remington, 2013; Shandro et al, 2011; Weber, Geigle, & Barkdull, 2014). This can be due to the growing stress and frustration of residents over the loss of jobs, neighbors, housing, and/or quality of life. A decrease in funding and local service providers as mining operation shut down and resources leave the region can lead to a lack of community health and social services to address these problems (Shandro et al, 2011).

The Controllability of Boom-Bust Impacts

The controllability of boom bust cycles depends largely on how much control a town has over the extraction industry in their area. A study by Apple (2014)

highlights the various degrees to which towns may control the extraction industry and the extent to which they may be impacted by boom-bust cycles. The study divides communities and their responses to the introduction of shale gas industry in their area into three categories: 1) the uncontrolled development scenario, 2) the at-risk development scenario, and 3) the controlled development scenario. Although the precise impacts on each community will differ and not all impacts can be predicted in advance, these scenarios broadly cover the myriad of ways social impacts of the boom-bust cycles can affect communities in the US.

Under the uncontrolled development scenario, local government has minimal control, if any, over the extraction process and its impacts on the municipality. This is typically due to the poor economic situation of the town and a lack of alternative means of bringing in revenue. The local government has little bargaining power to help control the impact of the fracking operation on the community due to the town's need for funds and lack of resources to obtain them. The town essentially develops into a company boomtown whose economy is largely controlled by the corporations at work in the region. There is an influx of people who support the drilling, and eventually an outflow of those who do not. A boom-bust cycle is highly probable in this scenario, as the community relies so heavily on the resource industry that when production slows and later disappears entirely, they have no other industry to fall back on to support their economy (Apple, 2014). These communities are, therefore, more likely to experience the negative social impacts associated with the boom and bust of the resource extraction industry.

Under an at-risk development scenario, there is a deep rift in the community between supporters of drilling and opponents. The control of the locals over the impacts of the mining activity on their town and their ability to capture benefits while minimizing negative social impacts is uncertain. The town will either deteriorate into uncontrolled development or find a way to stabilize and morph into a controlled development. Under a controlled development scenario, the local government has substantial control over the drilling and extraction processes and its impact on the community. The town also has notable control over the distribution of benefits derived from the industry, and implements measures to cover the costs incurred by the town due to the presence of the industry (Apple, 2014). The town is able to mitigate negative social impacts of the boom and bust of the resource industry within their municipality, and is less affected by the economic fluctuations than towns in uncontrolled scenarios.

Other Impacts

There are a myriad of impacts tied specifically to hydraulic fracturing and the resource extraction in general rather than to a boom or bust cycle. Many residents of shale gas regions claim to have experienced well water pollution, degradation of farmland, increased noise, air pollution that causes headaches, and increased truck traffic which causes dust (Apple, 2014; Ladd, 2013). The noise increase created by compressor stations, drill rigs, and truck traffic is typically among the first impacts to be noted after operations begin (Ladd, 2013). Infrastructure sees rapid deterioration due to the sudden increase in use and traffic, which creates a higher

burden on local government and taxpayers (Christopherson & Rightor, 2011). Road damage has been noted by a majority of the residents of high intensity drilling areas in Pennsylvania as having a “major” effect on the municipalities through the creation of traffic congestion and destroyed roadways (Schafft, Glenna, Green, & Borlu, 2014). These can add to the social disorganization in a community as local norms and the daily routines of residents are altered; it can also affect the health of residents as they carry out their daily lives in such an industrialized area.

Chapter 3

Current Social Impacts and Public Attitudes in the UK

The literature on impacts incurred by communities surrounding drill sites in the UK is currently rather sparse, likely due to the limited amount of hydraulic fracturing and shale gas extraction that has actually taken place in the country. There has been no commercial production of shale oil or gas to date, although exploratory drilling has been underway for several years (BGS, 2011a; Kotsakis, 2012; The Royal Society & Royal Academy of Engineers, 2012). Cuadrilla Resources, a UK based resource extraction company, has been the leader in UK shale gas development since receiving several exploration licenses in 2008 (BGS, 2011a). Cuadrilla's activity has received widespread attention from both the media and the government in the UK, particularly after drilling activity was found to be the cause of low-level earthquakes in the Blackpool, England area in 2011 (BBC, 2014; BGS, 2011a; Cotton, 2013). The British Geological Society (BGS) found that the earthquakes were most likely caused by fracking activity occurring at Cuadrilla's Preese Hall well site, which prompted the UK government to temporarily ban fracking while an investigation was conducted into the safety of the practice. This moratorium lasted until December of 2012 when a government report concluded that the drilling technique was safe to use and the practice could be resumed (BBC,

2014; The Royal Society & Royal Academy of Engineers, 2012). Even though fracking activities have been a permissible practice for over 2 years now, the public has not been so easily convinced of the safety of the practice (BBC, 2014; Robertson, 2014). Due to a lack of information on the social impacts currently induced by the UK shale gas industry, this public perception of the industry and its practices will be the main focus of this chapter.

UK Public Opinion of Shale Gas Development

There is extensive literature available expressing the public attitude toward exploratory drilling and the current fracking practices in the UK including news articles, surveys, and government reports. A few of the concerns expressed in public media or government publications include the potential for water contamination, frequent earthquakes, unequal distribution of benefits and risks associated with unconventional gas extraction, and the increase in truck traffic that drilling operations will create (BGS, 2011a; Cotton, 2013; Williams, 2014). Figure 3.1 below exhibits public perception of some of the various risks associated with fracking and the importance of these risks when making decisions about shale gas development. A report by the Economic Affairs Committee (EAC) to the House of Lords states that there is greater public concern over fracking in the UK than the US, and it is this type of local pushback that is holding up progress in the UK shale oil and gas industry (EAC, 2014).

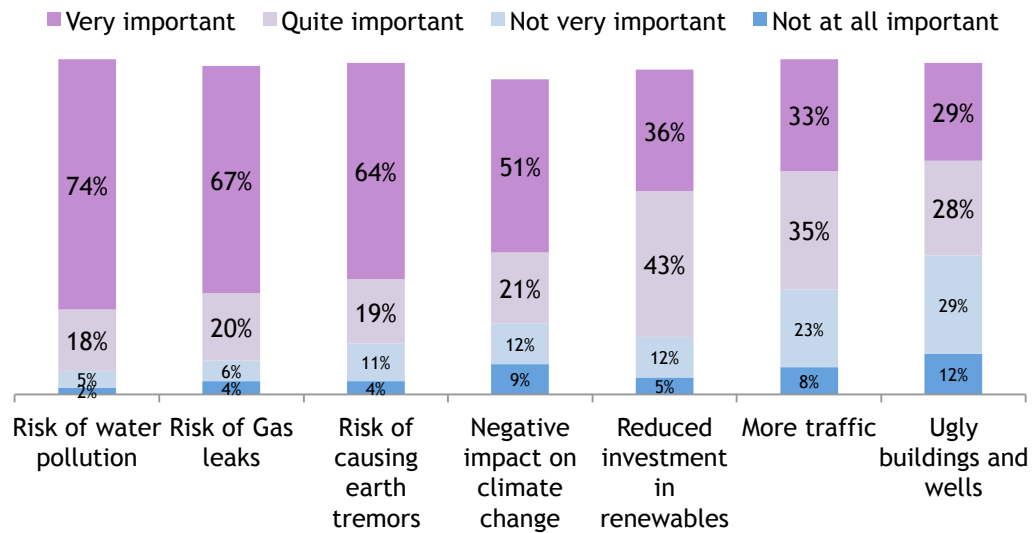
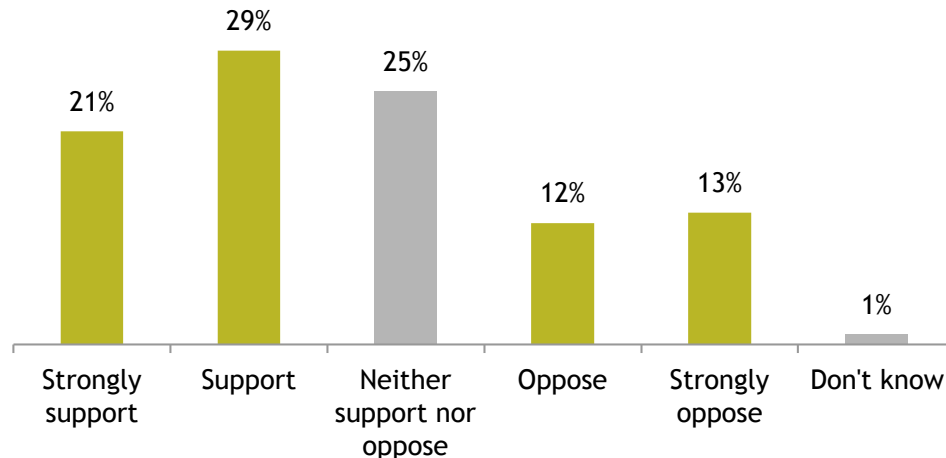


Figure 3.1 Perceived Risks of Hydraulic Fracturing. Survey results when respondents were asked to think about the potential disadvantages of fracking and to rate how important they thought each one is (Britain Thinks, 2012).

This is most evident in the amount of opposition that Cuadrilla has met with at several of its drill sites, many of which the company later abandoned its plans to frack (*BBC*, 2014; White, Fell, Smith & Keep, 2014). After the earthquakes at the Preese Hall well site, the anti-fracking organization Frack Off held demonstrations at the site. Following the protests and an investigation into the cause of the earthquakes, Cuadrilla announced that it was cancelling plans to further develop the site and would be sealing the well off. Cuadrilla's Westby site encountered opposition from the Defend Lytham group who claimed the drilling was too close to residential neighborhoods. The company ultimately abandoned the site in 2013 after announcing that they would not be applying for a permit to hydraulically fracture the well. Drilling operations were also stalled at Cuadrilla's Banks well site after Frack Off protestors invaded the site in 2012. The protestors were later

charged with trespass, assault, and obstruction; Cuadrilla announced that they will not resume plans to frack the well (BBC, 2014). These responses to public pressure exemplify the large extent to which drilling companies rely on public acceptance in order to operate. It also exemplifies how much public fear and doubt over the safety of industry practices can slow the growth of shale gas development.

Recent survey data has shown that the UK public is generally well educated on shale gas and the issues surrounding its extraction. As of March 2013, over 50% of UK citizens surveyed could accurately identify shale gas based on a short description of where it may be found and how it can be recovered (Williams, 2014). The results of a survey conducted by Britain Thinks in 2012 show that many UK citizens are also aware of potential benefits from shale gas extraction, the most prominent of which are lower energy costs and increased job opportunities (Britain Thinks, 2012; Williams, 2014). As seen in figure 3.2, there appears to be strong support for the continued exploration and potential development of shale gas resources in this survey. Approximately 50% of respondents claim they support further exploration in local areas whereas only 25% oppose further exploration (Britain Thinks, 2012). This data is somewhat contradictory when coupled with surveys on support for hydraulic fracturing, though. Polls have found that only 44% of respondents are in favor of fracking in Britain, a figure that drops to 41% when asked in regards to the respondent's local area. The percent of those opposed to fracking also increases from 30% in regards to Britain as a whole to 40% when applied specifically to the respondent's local area (Britain Thinks, 2012; Williams, 2014).



Q: How much do you support continuing exploration, in your area, to understand the potential for natural gas from shale in the UK? Base: All respondents (n=503)

Figure 3.2 Public support for exploratory activity in the UK. Survey results when respondents were asked how much they support continued shale gas exploration in their local area (Britain Thinks, 2012).

The public appears to be fairly evenly split over the issue of whether or not to support hydraulic fracturing in the UK. There is notable discord between the support for the extraction of shale gas and the support for hydraulic fracturing, underlining the controversial nature of fracking practices. This important difference in the data seems to show that though many citizens would like to see the benefits of shale gas exploration and extraction, they are not prepared to suffer the risks that come with the extraction methods. These data also provide evidence that a significant portion of the public is still undecided as to whether it supports or opposes fracking. This lack of conviction is a major reason why it is so difficult for the industry to garner public acceptance at the local level.

The heightened concern over the risks of fracking in the UK as opposed to the US may be due in part to a lack of economic incentive for landowners and community residents to accept such hazards. Economic benefits are likely to be

lower for individual landowners in the UK than they are for those in the US as the Crown owns all mineral rights to certain substances in the UK, including oil and gas. This ownership was established through the Petroleum Act of 1934 and the Continental Shelf Act of 1964, and more recently reiterated in the Petroleum Act of 1998. The legislation gives ownership of both onshore and offshore oil and gas to the Crown, but allows the government to grant licenses to private parties for exploration and extraction (BGS, 2011a; BGS, 2011b; Greatrex, 2002). This means that no royalty payments will be made to property owners, as they have no authority to lease out mineral rights to shale oil and gas extraction companies (Jacquet, 2012). The requirement of royalty payments to the Crown has also been absent since 2002 when all royalty payments were abolished (Greatrex, 2002). This could make the negative impacts of fracking much more visible to members of the affected communities as they will not be overshadowed by the direct monetary benefits that tend to generate greater tolerance of the practice in the US. It may also make absent the haves vs. have-nots mentality that has been seen to arise in the US due to the difference in perspective between landowners benefiting from royalties and those who are not (Jacquet, 2012).

Community Benefit Mechanisms

The UK public is not entirely lacking in monetary incentives to support industry, though. The main form of economic incentive seen by UK residents comes in the form of community benefit schemes. Several community benefit plans have been proposed by companies in order to compensate residents for any negative

impacts they may experience due to extraction activities, although no plan has been formally adopted into legislation by the UK government to date. The UK Onshore Operator's Group (UKOOG) announced plans in January of 2014 for the development of a community benefit program in which £100,000 will be granted to the community per hydraulically fractured well after planning consent is granted and exploratory drilling begins (EAC, 2014; Nichols, 2014). These funds are meant to counteract the costs that the community may incur as a result of industry operations. The shale oil and gas industry has also announced plans for each operator to develop its own "community benefit mechanism" which will seek to contribute 1% of the revenue garnered from each well site to the affected community (Robertson, 2014).

This initiative has received public support from the national government, but the Local Government Association (LGA) has argued that 1% is far too low of a figure to truly benefit communities (EAC, 2014). When compared to US royalty payment schemes, which typically range between 12.5- 20%, it seems reasonable for UK communities to feel they are being inadequately compensated (Robertson, 2014). There is evidence of widespread concern over the distributive fairness of the benefits and risks of resource extraction. Much of the available literature notes concern by communities over the fact that they will receive the main impact of any risks associated with hydraulic fracturing, while the companies and the government will receive the vast majority of benefits with little real risk (Cotton, 2013; Williams, 2014).

Some action has been taken by individual companies to address these public concerns over just compensation and distributive fairness. In September of 2014, INEOS Corporation announced that its community benefit plan will distribute 6% of shale gas revenues to communities, homeowners, and landowners in close proximity to its well sites. The company plans to give homeowners and landowners directly above well sites 4% of revenues, and nearby communities 2% of revenues. The total estimated benefit to these owners and communities over the life of INEOS operations is over £2.5 billion. This scheme is the first of its kind to be announced by shale gas producers in the UK; INEOS Chairman, Jim Ratcliffe, claims that it is an attempt to share the benefits of shale gas extraction fairly (INEOS, 2014; Robertson, 2014). This increased fairness could help alleviate concerns over the fairness of how benefits and risks are distributed in the shale gas industry. Having such a scheme in place, though, could also give rise to greater social tensions in communities. Having landowners directly above well sites receiving greater direct monetary benefits from the extraction industry than the rest of the community may facilitate the type of haves v. have-nots rift that is so common in US communities.

There is extensive literature on the ability of adequate compensation packages to foster greater community acceptance of controversial practices (Cotton, 2013). Community benefit mechanisms such as these have been noted by researchers for being important tools in fostering more positive relations between resource extraction companies and communities, but they currently seem to be fueling local opposition more than acceptance. In response to the announcement of INEOS benefits, the Country Land and Business Association stated that the proposal

“does nothing to address the liability concerns we have if anything goes wrong, after operations have been wound up or companies have gone out of business” (Drill or Drop, 2014). This skeptical reaction to the announcement of community benefit schemes has proven common amongst the UK public, much to the disadvantage of extraction companies. Local support is imperative to these companies as they must receive permits from the local government in order to construct well sites (Cotton, 2013; Kotsakis, 2012).

Monetary Compensation and Community Acceptance

Many news sources and anti-fracking organizations have labeled plans to channel revenues from shale gas and oil extraction to communities as an attempt by industry and government to buy the support of residents and local authorities; thus making the benefit programs appear to be a form of bribery (Drill or Drop, 2014; Nichols, 2014; Robertson, 2014). The use of monetary compensation in exchange for the acceptance of controversial practices introduces the idea that acceptance can be bought and a blind eye can be turned toward risk factors. This directly undermines perceptions of honesty and fairness in the public engagement process (Cotton, 2013). By making the relationship between corporation and community resident a transactional one, the extraction companies may be perpetuating the sense of distrust that already exists between communities and corporations while reinforcing the idea that companies are more focused on the ability to turn profits than in looking out for the greater interest of the public (Cotton, 2013; Williams, 2014).

Science and Technology Studies (STS) literature has frequently argued that the public engagement processes carried out by government and corporations are ultimately motivated by the desire to create greater public acceptance rather than to create openness and inclusion of the community. Public acceptability has proven to be greater for those projects that are designed first and foremost with the public interest in mind than those which revolve around commercial gain (Williams, 2014). The negative response to community benefit proposals makes it clear that a large portion of the public sees the actions of resource extraction companies as motivated solely by commercial interests and not by concern for the public good. Energy companies have become a symbol of greed to a large portion of the public as fuel poverty becomes a growing social issue in the UK, and their focus on monetary benefits throughout public engagement efforts only gives further credit to this idea (Williams, 2014). By focusing solely on the profitability of shale gas development, the corporations are reinforcing the long-held public opinion that energy corporations cannot be trusted to put the overall good of the community ahead of the commercial goals of the company. This could be one reason that public acceptance is so difficult to gain for UK shale gas companies despite widespread public engagement programs

STS literature also states that the concerns held by the public often revolve around the misrepresentation by science and the extraction companies of the degree of control and predictability that exists in the extraction process and their refusal to give adequate consideration to contingency factors in risk assessments (Williams, 2014). Public engagement efforts whose sole purpose is to foster

community acceptance of risky practices may perpetuate these concerns rather than allaying them. Companies and organizations often emphasize the precision and predictability of the practice and downplay the risks in effort to minimize public fear, but this practice merely reinforces public opinion that the image being provided to them about extraction processes is unrealistic and that companies cannot be counted on to give the necessary consideration to risk factors. These continued concerns may be additional factors as to why there is such a high degree of pushback against hydraulic fracturing by local residents in the UK.

Chapter 4

Hydraulic Fracturing Practices and Regulatory Regimes in the US and UK

This chapter will serve to outline the current hydraulic fracturing practices in the US and the UK, and to provide selected comparisons of the current regulatory regimes concerning the extraction of shale gas in each country. This comparison is necessary in order to adequately infer from the US experience what the potential social impacts of hydraulic fracturing may be in the UK. In order to avoid getting too invested in the minor details and variations in US and UK regulations and practices, only major difference will be explored in this chapter. These are variances in industry size, property rights, and regulations that seem substantial enough to create differences in the way UK communities are impacted by the development of the shale gas industry as opposed to communities in the US.

The Scope of Hydraulic Fracturing in the US

Hydraulic fracturing has been in use in the US crude oil extraction industry since the 1940s, although it wasn't until its application to the shale oil and gas industry that the practice became widely known and highly criticized. The development of hydraulic fracturing technology has played an indispensable role in the growth of the shale gas industry, creating a boom in domestic natural gas

production in the US. As of 2000 shale gas made up only 2% of domestically produced natural gas in the US, but by 2011 it made up 37% of all domestic natural gas produced (Merrill & Schizer, 2013). Approximately 23 trillion cubic feet of natural gas was produced as of 2011, meaning that around 95% of the natural gas consumed in the US was produced domestically (Adgate, Bernard, & McKenzie, 2014). This has not only led to a notable amount of increased energy independence for the nation, but has placed US gas prices at about 60% that of European gas prices and 20% that of gas prices in Asia (Merrill & Schizer, 2013; Wang, Chen, Jha, Rogers, 2014).

This new supply of cheap domestic energy has been cited as the catalyst of significant economic growth. As of 2012, \$87 billion in capital investments had been generated by the US shale oil and gas industry, a figure expected to reach \$172.5 billion by 2020 (Merrill & Schizer, 2013). A study on Colorado, Texas, and Wyoming natural gas industries found that approximately 2.35 local jobs are created for every \$1 million of gas produced (Popkin, Duke, Borchers, & Ilvento, 2013). HIS Global Insight estimated that in 2013, the US shale gas industry alone directly supported about 600,000 jobs and had an employment multiplier of 4:1 (Merrill & Schizer, 2013; Wang, Chen, Jha, Rogers, 2014). This means that for every one drilling job created in the shale gas industry, approximately four other jobs are created outside the industry. These typically include surveying jobs, financial services positions, machinery supply jobs, or retail positions.

US Regulation of Shale Gas Development

The regulation of this booming industry falls largely into the hands of each individual state. Although each state may have some slight variations in regulation, they generally address the same issues and components of the extraction process (Boxerman & Visser, 2012; White, Fell, Smith & Keep, 2014). For the purpose of this paper, we will focus on the regulatory regimes of Pennsylvania in regards to the Marcellus Shale Play. The Marcellus Shale Play is one of the most prominent shale plays in the US and is frequently used by the UK government as a point of comparison (Boxerman & Visser, 2012; EAC, 2014; Lipscomb, Wang, & Kilpatrick, 2012). The Marcellus Shale is approximately 95,000 sq. mi. extending from New York State southward to West Virginia and Ohio, and covering approximately 60% of Pennsylvania (Lipscomb, Wang, & Kilpatrick, 2012; Popkin, Duke, Borchers, & Ilvento, 2013).

Under Pennsylvania law, as in many other US states, drilling companies must obtain leases from property owners in order to carry out operations on private land. Leases are typically 5-10 year contracts providing for a per-acre fee to be paid by the drilling company to the landowner whether operations take place or not (Jacquet, 2012). Standard gas leases in the US include the right to use portions of the land surface in order to build well pads, install roads, establish pipelines, and construct various other facilities as needed (Radow, Esq, 2014). The companies are then required to send notice to both surface landowners and estate owners under whose property they intend to operate, as well as to any water purveyors owning water supplies within 1,000 ft of the well location. Drilling operators must then

apply to a state agency for a drilling permit, which are typically priced by wellbore length and cost around \$5,000 (Gopalakrishnan & Klaiber, 2013).

In 2012, Pennsylvania passed Act 13 in order to directly address the growing shale oil and gas industry. The Act establishes a fee to be paid by companies developing unconventional gas operations, which aims to compensate local communities for any negative impacts they experience due to the operations. The Act also established an Oil and Gas Lease Fund, which is designed to retain revenues to compensate communities in the case of substantial damages being caused by shale gas operators (Gopalakrishnan & Klaiber, 2013; Lipscomb, Wang, & Kilpatrick, 2012). Additionally, Act 13 requires that local ordinances regarding oil and gas operations must permit the “reasonable development of oil and gas resources.” This requirement has raised much concern amongst municipalities throughout the state as it diminishes the power of local government to use zoning laws as a means to regulate the placement of oil and gas operations. Many Pennsylvania municipalities filed suit in the Commonwealth Court of Pennsylvania to challenge this provisions (Lipscomb, Wang, & Kilpatrick, 2012). The case eventually made its way to the Supreme Court of Pennsylvania where it was deemed unconstitutional to restrict local zoning for natural gas development in this manner (Mercer, 2014). It is through court cases such as these that local planning authority to control the siting and development of well sites has been notably increased for the US as a whole in recent years (Jacquet, 2012).

The expansion of the US shale oil and gas industry has had significant effects on not only the domestic energy market, but global markets as well; namely that for

the first time in history the price of natural gas is not indexed to the price of oil, but to the main US gas benchmark, Henry Hub (Wang, Chen, Jha, Rogers, 2014). Due to cheap energy prices, international corporations such as Methanex, Chevron, Exxon Mobil, Dow Chemical, and a multitude of others have moved new operations to the US (Merrill & Schizer, 2013). With the US having such notable success in the use of hydraulic fracturing to produce shale oil and gas, it is little surprise that the UK wishes to further expand its own shale gas industry. It is important to note that shale gas is not expected to be such a game-changer for the UK energy industry, however. The structure and regulation of the industry will also not be an exact replica of the US shale gas industry, although the country will be able to build off the already proven techniques and learn from the mistakes of the US industry (EAC, 2014; White, Fell, Smith & Keep, 2014).

Hydraulic Fracturing in the UK

Hydraulic fracturing was first used for commercial production of oil in the UK during the late 1970s, with British Gas using hydraulic fracturing to develop its Wytch Farm field in 1979. This field was later taken over by British Petroleum and today is the largest onshore oil field in the UK. More than 2,000 onshore wells have been drilled in the UK in the last 30 years, of which approximately 10% have been hydraulically fractured. The first gas field to be hydraulically fractured and successfully produce gas was developed by British Gas in 1996, and has since been taken over by Cuadrilla Resources (The Royal Society & The Royal Academy of Engineers, 2012). To date, offshore oil production in the North Sea has been the

major resource extraction industry in the UK. The total amounts of UK offshore oil produced between 1975 and 2010 can be seen in figure 4.1. 2011 proved to be a pivotal year for the nation as North Sea Oil production fell below 1 million barrels per day for the first time since its development and natural gas imports hit a historical high (EAC, 2014; White, Fell, Smith & Keep, 2014). With the North Sea reaching maturity, the government has put greater emphasis on alternative fuel options, such as unconventional natural gas. The UK's increased reliance on natural gas is visible in figure 4.2, which shows the total amount of natural gas produced, imported, and exported between 2001 and 2008. Exploiting shale for hydrocarbons is not a new idea in the UK, though. Scotland claims to have established a notable shale oil industry as early as the 19th century; but without the technology to make shale oil extraction efficient, it simply could not compete in the energy market and thus faded out in the 1950s (EAC, 2014). With the recent development of hydraulic fracturing technology, there is renewed hope in these shale reserves as viable energy sources.

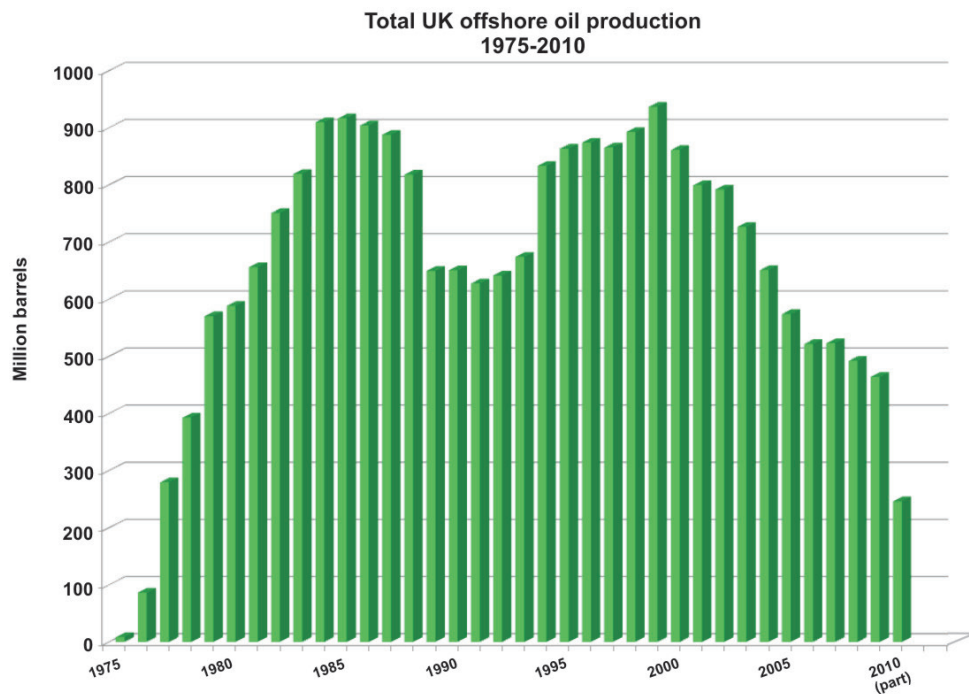


Figure 4.1 Total UK offshore oil production. Total annual UK offshore oil production from 1975-2010 (BGS, 2011b).

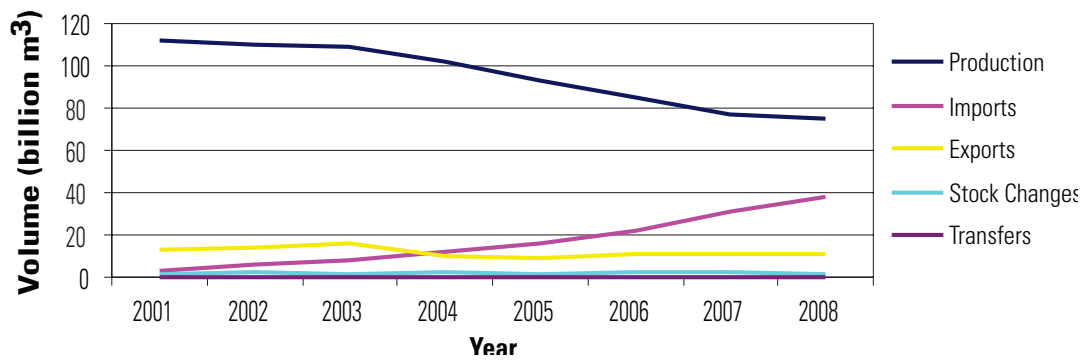


Figure 4.2 Total UK natural gas production, import, and export. Total UK natural gas production, imports, and exports between 2001 and 2008 (BGS, 2011b).

Available Resources.

There are currently no solid figures on the total amount of recoverable shale gas existing in the UK, but the British Geological Survey (BGS) has published estimates of the total amount of gas that could be present in three of the UK's major shale reserves. A map of the major known UK shale plays is provided in figure 4.3. It is important to note that only about 15-30% of unconventional gas is actually recoverable through drilling operations (White, Fell, Smith & Keep, 2014). About 1300 trillion cubic feet (tcf) of gas is thought to be present in the Bowland Shale Basin of central Britain; 591 million tons of shale oil are estimated to exist in the Weald Basin, but no gas resources are thought to exist here; and approximately 80.6 tcf of shale gas is estimated to lie in the Midland Valley of Scotland (BGS, 2014). A May 2013 report by the Institute of Directors, a UK membership organization made up of business leaders and professionals, stated that UK shale gas production could potentially attract £3.7 billion in investment per year and support 74,000 jobs (White, Fell, Smith & Keep, 2014). While still a notable figure, this measurement makes it clear that the UK shale gas industry will be significantly smaller than that of the US. This is due mainly to the smaller amount of land that the UK will be operating in, as well as geological differences between the countries (EAC, 2014).

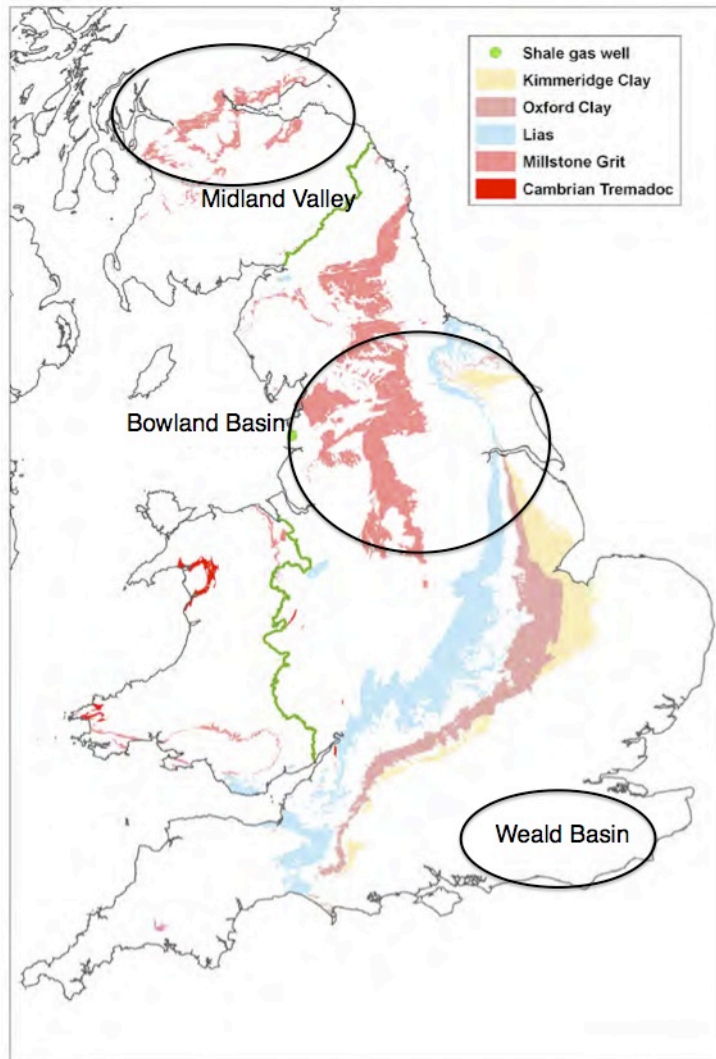


Figure 4.3 UK shale gas basins. This map outlines the shale and clay formations throughout the UK that hold the potential to produce shale gas (BGS, 2011a).

Extraction Companies.

There are 5 major resource extraction companies currently involved in shale gas exploratory activities in the UK. First and foremost is the UK-based company Cuadrilla, which has operations in place in the both the Lancashire region of North West England and the West Sussex region of South East England. The company was formed in 2007 and currently employs approximately 70 staff members in the UK.

Cuadrilla has been identified as the UK shale gas industry leader, and has been conducting extensive exploratory drilling in the Bowland Shale basin since 2010. The company currently claims a total of eleven well sites including active and inactive drill sites and wells for monitoring seismic activity. Cuadrilla claims to only have plans for future shale gas exploratory operations at five of these sites. The company also currently produces conventional natural gas from a single well site in Elswick, which is then used to produce electricity (Cuadrilla, 2015a).

INEOS, one of the world's largest chemical companies, has also invested in the UK shale gas industry. INEOS claims to hold approximately 12% of their business in the UK, which makes shale gas development appear to be just a small portion of their investments (INEOS, 2015). INEOS currently holds two licenses to drill sites in Scotland from which it hopes to someday be able to extract shale gas to use in the production of chemicals at its Grangemouth petrochemicals plant. The Grangemouth plant has been hailed as Scotland's most important industrial complex and it has suffered from rising production costs as oil supplies from the North Sea diminish (Dickie, 2015). This plan to renew plant profitability through the use of locally sourced shale gas has run into some severe challenges since January of 2015, though. The Scottish Parliament has passed a moratorium on all unconventional oil and gas planning applications and hydraulic fracturing operations. This new legislation is a significant turn of events in UK shale gas development as it prevents companies like INEOS from carrying out any exploration or production activities within the nation until government studies can conclude that extraction practices are safe (Dickie, 2015).

A third major player in the UK shale gas industry is IGas Energy, Plc, one of the UK's leading onshore oil and gas production companies. The UK-based business has been in operation for over thirty years and currently has conventional oil and gas production facilities located across England and parts of Scotland. Like Cuadrilla, IGas's shale gas exploratory operations are concentrated in the North West Region of England. As of January 2015, the company had drilled three shale gas wells and was preparing to enter the planning process for a fourth (Gosden, 2015). None of these wells have been hydraulically fractured thus far, and IGas has submitted no applications for permission to do so in the future. The company states that they are using the current wells to collect rock samples and data in order to determine the potential viability of well sites (IGas, 2014a).

Two of the smaller players in shale gas development are Third Energy and Celtique Energie. Third Energy is a gas company that successfully runs conventional gas operations both offshore in the North Sea and onshore in the Yorkshire region of England (Third Energy, 2012). The company currently possesses a single shale gas exploratory site within their existing conventional gas field at Kirby Misperton in North Yorkshire. This well is known as the KM8 well site, and they company has recently announced plans to apply for permission to hydraulically fracture the well (Third Energy, 2014). Celtique Energie is a European oil and gas company that currently has operations in the UK, France, Germany, Poland, and Switzerland. The company holds three licenses to explore sites in the Weald basin of South East region of England, five licenses for sites in the East Midlands, and one license for the Cheshire region (Celtique Energie, n.d.). They have thus far submitted two shale gas

well planning applications, both for the West Sussex region of South East England. Both planning applications were rejected by the local planning authority, but one proposal is on appeal as the company believes it was unjustly rejected (Celtique Energie, 2014).

UK Regulation of Shale Gas Development

The regulation of fracking in the UK is largely conducted by the national government through agencies such as the Environmental Agency (EA), the Department of Energy and Climate Change (DECC), the Health and Safety Executive (HSE), and the Health Protection Agency (HPA). The British government is now in its fourteenth round of Onshore Licensing to resource extraction companies (The Royal Society & The Royal Society of Engineers, 2012). These Petroleum Exploration and Development Licenses (PEDLs) are granted by the DECC and are valid for up to 6 years. Initial granting of PED licenses does not give the right to drill, only to carry out exploratory activities; further consent must be garnered from the DECC and other regulatory agencies before drilling or hydraulic fracturing may be carried out, although no new license must be acquired (EAC, 2014). Regulation to monitor the growing shale gas industry in the UK is relatively new and in many regards still being created. Currently, the three main focuses of regulation are the environmental and health impacts of fracking, the management of water and waste, and the maintenance of well integrity. These are all presently addressed through various licensing procedures and monitoring systems, which this paper will briefly cover in order to compare UK regulation to that of the US (Kotsakis, 2012).

Once a company has acquired a PED License from the DECC, it must then submit an application to the relevant Minerals Planning Authority (MPA) for the local region in which drillers wish to conduct operations in order to garner permission to develop an exploratory well. These local planning authorities are typically county councils, which have the ability to regulate the placement and construction of wells in their region through a process similar to that used by US local authorities to control the siting of gas wells (EAC, 2014; Jacquet, 2012; Kotsakis, 2012). The local MPA will consider factors such as environmental risks, traffic volume, groundwater resources, local seismicity and waste management plans in determining whether or not to grant the application to construct a well. If operators intend to frack the well, the DECC also requires an environmental risk assessment (ERA) to be conducted before they will grant consent for fracking activities. The ERA assesses the environmental risks associated with the full cycle of well site activities and is suggested as one of the first steps operators should take in seeking consent to carry out drilling operations as both the DECC and the local MPA will likely use this assessment in deciding whether to approve or deny well plans.

If the MPA believes the proposed operation will have significant environmental impacts, the local authority maintains the ability to require an environmental impact assessment (EIA) in addition to the ERA required by the DECC (EAC, 2014; Kotsakis, 2012). Requirements for EIA content will be determined for each well site by the local MPA, but the assessment is meant to build upon the information in the Environmental Risk Assessment (ERA). Ultimately, all EIA's will consist of detailed information about the development and the site on which it is

placed, as well as an outline of its main environmental impacts, details of any alternative practices that were studied or considered by the operators, and the reason for which they chose to take their current course of action (DECC, 2013). After the results of the EIA are presented and the planning application is submitted to the MPA, the authority will have a brief consulting period of about twenty-one days in which all interested parties may provide feedback on the application. The EA acts as a consultant during this feedback period, providing an additional opinion of the finding of the EIA (EAC, 2014).

Once all relevant assessments have been added to the planning application, the local authority will either grant or deny permission for the company to construct a well. Permission is typically determined between thirteen and sixteen weeks from the date of initial application. If planning permission is denied, the operators may appeal the decision to the Secretary of State for Communities and Local Government (EAC, 2014). This appeals process limits the authority of local government to determine where extraction operations will be conducted in much the same way as Pennsylvania's Act 13. Both give an outside agency the ability to strike down decisions of local planning authorities if they deem the rationale behind their decision-making to be unreasonable. Even upon receiving consent to conduct exploratory drilling via the appeals process, though, companies must still obtain all relevant permits and consents from national regulatory agencies such as the DECC, EA, and HSE.

Before drilling may begin, well operators must provide notice the EA and obtain all relevant environmental permits for their operations. These permits

include a water abstraction license from the EA for any operations where over 20 cubic meters of water will be removed from surface or groundwater sources, which would apply to all fracking operations. These licenses will only be given if the EA determines that the drilling area can sustain the amount of water extraction that will take place due to drilling activities (EAC, 2014; Kotsakis, 2012; The Royal Society & The Royal Academy of Engineers, 2012). It is interesting to note that the UK does not allow for hydraulic fracturing above freshwater aquifers that are in use as drinking water supplies, whereas in the US drilling can occur within 50 ft. of public and private water supplies as long as the well casings are deemed “sufficient to protect all freshwater” (Boxerman & Visser, 2012; Kotsakis, 2012).

Well operators must also notify the HSE of their intent to drill at least 21 days in advance. This notice involves the submission of many documents, including details on equipment to be used, diagrams of well paths, data on the geological make-up of the drill site, and other operational details. Drilling operators must also have the well design inspected by an independent well examiner in order to verify the soundness and safety of the well construct (Kotsakis, 2012). For wells that are to be hydraulically fractured, the EA and the HSE have formed a joint inspections team to monitor the well throughout fracking operations (EAC, 2014). There is no such national well inspections scheme in place in the US, although some states such as Pennsylvania and Colorado require pre-fracturing testing or monitoring throughout the fracking process to ensure that the well casings are able to withstand the pressures of the procedure (Boxerman & Visser, 2012).

Once all required permits have been acquired and the proper agencies have been notified of drilling activity, the well operators must seek final consent to drill and fracture from the DECC. In order to receive this consent, operators must exhibit full understanding of the risks of their drilling activities and have a traffic light system in place to monitor potential risks throughout operations (EAC, 2014). Once final consent is given by the DECC, companies may finally begin conducting drilling operations. Figure 4.5 below provides a general outline of the entire regulatory process a drilling company must go through in order to carry out exploratory activities. As is evident in this overview of the regulatory procedure, UK regulations and guidelines are mainly purposed to mitigate the environmental risks of drilling and extraction and place little to no emphasis on managing social impacts.

Steps through the regulatory process Exploration and Appraisal Wells

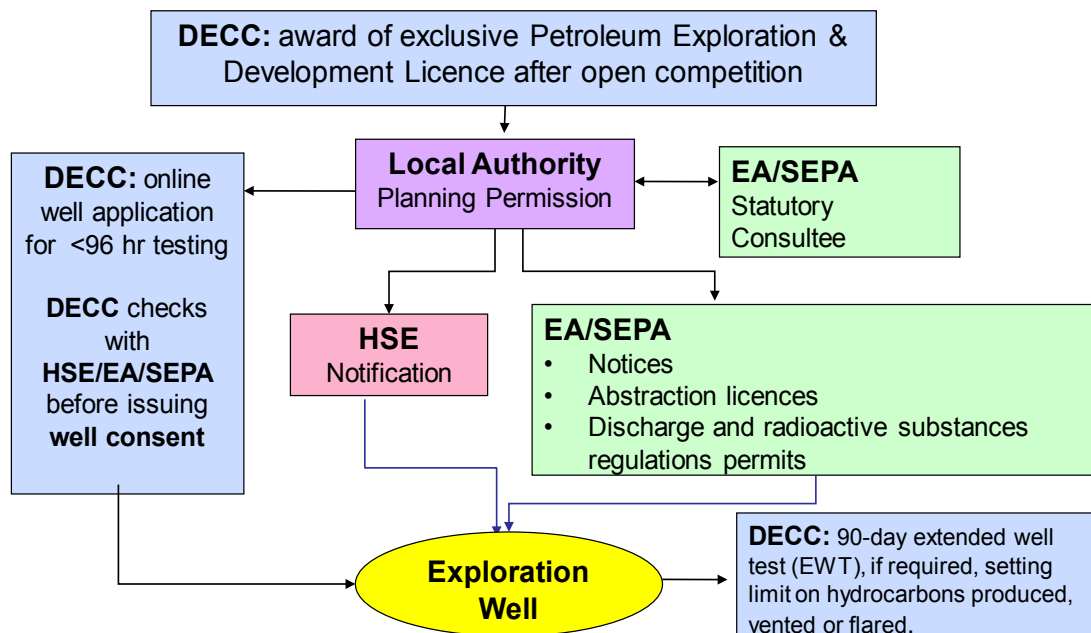


Figure 4.5 UK regulatory process for shale gas well development. outlines the major steps in the regulatory process for the construction of onshore shale gas wells in the UK (UKOOG, 2013).

Environmental risk and water management.

The UK places significant focus on environmental impacts and water management, as is evidenced by their attempts to learn from US practices and avoid the problems that arise from relaxed environmental regulatory regimes (Kotsakis, 2012). US regulation leaves environmental protection largely up to the states, whereas in the UK there is national legislation regarding the environmental risks associated with shale gas extraction (Royal Society & The Royal Academy of Engineers, 2012). UK authorities and organizations tend to see the fragmented state regulations of the US as weak. This is due to the allowance of risky procedures such as drilling near drinking water sources and preventing the disclosure of fracking chemicals, which can ultimately result in groundwater contamination, poor well construction and a lack of adequate monitoring (Kotsakis, 2012; The Royal Society & The Royal Academy of Engineers, 2012; White, Fell, Smith & Keep, 2014). UK regulations are of a more precautionary nature and are touted as being more stringent and effective at preventing mishaps in the industry (EAC, 2014; Kotsakis, 2012; The Royal Society & The Royal Academy of Engineers, 2012). UK Regulation of the onshore shale gas industry borrows heavily from previously established offshore drilling regulations, which are considered to be among the most stringent safety regimes in the world. It is hoped that these rigid regulations will minimize the risk of environmental damage as seen in the US and give the public greater confidence in the UK shale oil and gas industry, thus fostering greater public acceptance (EAC, 2014;).

In the US, hydraulic fracturing is not considered an ‘underground injection’ and, therefore, is exempted from having to comply with federal regulations on water contamination. In the UK, however, fracking is labeled as a fluid injection and as such is regulated by the EA, which has a specific permitting process for groundwater activity (EAC, 2014; Kotsakis, 2012). UK drill operators must also register chemicals to be used in fracking fluids with the European Chemical and Health Agency (ECHA). A chemical safety assessment is required to be conducted for each substance and is then submitted to the ECHA as well. These requirements are part of the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)² regulation imposed by the European Union (EU), of which the UK is a member (Kotsakis, 2012). This practice of identifying and publishing the contents of fracking fluids in Europe is in direct contrast to those of the US, where the content of fracking fluids is protected as an industry secret. The disclosure of this information creates greater transparency in the UK fracking industry, which may in turn allow regulators to better assess risks and foster a more positive public opinion of the shale gas industry (Kotsakis, 2012).

² REACH regulation was implemented in 2007 in order to promote human and environmental health protection from chemical hazards. The regulation requires all chemical substances used in both industrial processes and everyday consumer products in the EU to be registered with the ECHA. It requires a hazard assessment to be conducted on each chemical and places burden on the companies using the chemical to identify and manage the risks associated with that substance. The companies must also demonstrate how the chemical may be safely utilized and provide this information to consumers. The ECHA will then evaluate the hazard assessment and all other information provided to determine whether use of the chemical will be allowed, restricted, or banned in EU member states (ECHA, 2014).

Rights of Property Owners

Another significant difference between the laws regarding shale gas extraction in the UK and the US stems from the fact that all shale deposits are state owned in the UK. Landowners may possess surface rights, but the Parliament at Westminster granted the Crown ownership of all subterranean petroleum in 1934 (EAC, 2014; Kotsakis, 2012). In the US, subsurface and mineral rights to property are typically owned by private citizens, although in some cases they may be owned by a different individual than that which owns the surface rights to the property (Lipscomb, Wang, & Kilpatrick, 2012). Historically, UK drilling companies were required by law to obtain permission from the landowner as well as a government license in order to operate on or beneath the landowner's property. Compliance by the landowner could also be acquired by force through a referral to the High Court, which would either grant or deny the right of the company to operate on the property and determine the compensation for the landowner (EAC, 2014).

In 2014, though, an Infrastructure Bill was proposed to streamline access of drilling companies to land belonging to private citizens (White, Fell, Smith & Keep, 2014). This amendment to current law was publicly announced during the 2014 Queen's Speech. The changes would establish three things:

- 1) Access rights to extraction companies for petroleum resources and geothermal energy in land at least 300 meters below the surface
- 2) Voluntary payments by the company to communities of £ 20,000 per horizontal well extending more than 200 meters in length

- 3) A public notification system in which companies must publish drilling proposals and details for the voluntary payments

These changes were passed in the House of Lords in October of 2014 and passed into law by Royal Assent in February of 2015 despite overwhelming public opposition to the proposed amendments. A survey by YouGov showed 74% of respondents opposing any changes that would allow companies to drill beneath private property without permission from the landowner (Robertson, 2014; White, Fell, Smith, & Keep, 2014). Ken Cronin, Chief Executive of UKOOG, attempted to justify the amendments by stating that “landowners on the surface will not notice this underground activity, it will have no impact on their day-to-day lives and, at this depth, the land is not in use by the landowner.” This is a significant difference in law to take into account when comparing the UK industry to that of the US, where landowner permission is required before any drilling activity may be permitted. By eliminating the need for landowner permission, the government has essentially made the control of landowners over industry activity much lower in the UK than in the US. Granted that in the US there are various procedures and state laws that can force landowners to give drilling permission, similar to that of the UK’s previous law allowing the High Court to require landowners to grant access to their land (Lipscomb, Wang, & Kilpatrick, 2012; Radow, 2014).

Another important development in UK regulation of the onshore oil and gas industry came in January 2014 when the Town and Country Planning Order 2013 went into effect. This Planning Order removes the requirement of extraction companies to notify landowners of underground development being carried out

beneath the land while retaining the notification requirement for those activities being carried out on the surface of the land (White, Fell, Smith, & Keep, 2014). This essentially means that land owners could have horizontal wells and extraction activities being carried out beneath the surface of their land and not be made aware of it. This controversial piece of legislation is at direct odds with US law, which typically requires landowners to be notified within a certain timeframe of any activity being carried out beneath the surface of their property. Pennsylvania in particular requires that drilling operators notify owners of both the land and any estates on which drilling is to be carried out, as well as those owning water supplies within 1,000 ft. of a well site (Gopalakrishnan & Klaiber, 2013). The negative effects of this legislation could potentially be minimized by the public notification requirement outlined in the 2014 Infrastructure Bill, but it is currently unclear how effective such a notification scheme would be at informing land owners of local activity.

Chapter 5

Characteristics of Communities Surrounding Drill Sites

In order to predict how similar the impacts from hydraulic fracturing will be on communities in the UK as compared to those in the US, it's important to determine how similarly situated the communities are. The location, size, economy, and general makeup of communities play a large role in how they are impacted by the presence of a growing resource extraction industry. Those communities that are similarly situated will often be similarly impacted by the introduction of a booming mining industry into their region, whereas dissimilar communities are less likely to be affected in the same ways. Therefore, it is important to note the significant similarities and differences between communities in the US and the UK before making predictions as to what social impacts fracking may have on UK communities.

General Characteristics of Shale Gas Communities

Geographic limitations affect where fracking may occur and include: the location and potential productivity of shale reserves; the presence of appropriate infrastructure, which must be utilized to give trucks access to well sites; and the density of cities on top of the shale reserves, which must be fairly low (Apple, 2014). Due to these limitations, communities closest in proximity to shale gas wells in the

US tend to be rural and have few existing industries to support them (Jacquet, 2012; Lipscomb, Wang, & Kilpatrick, 2012; Weber, Geigle, & Barkdull, 2014). Rural areas typically rely on agriculture, tourism, and recreation industries to bring in revenue, making the land their most valuable asset (Deller & Schreiber, 2012). The economic situation in these communities is typically poor, and low-income communities tend to lack the resources needed to deter fracking development or to employ alternative means to bring jobs and revenue into the region (Apple, 2014). Poorer communities, in effect, have a higher utility for the benefits of fracking and, therefore, are more willing to accept the risks than wealthier communities that have alternative means of boosting their local economies.

Thus far, there are only six shale gas wells in existence in the UK, although an additional eleven wells are planned to be drilled in 2015. Cuadrilla has proposed eight of the eleven wells, IGas has proposed two and Celtique Energie has proposed one new well. If all eleven planned wells are drilled, this will bring the total number of UK shale gas wells up to seventeen (Gosden & Shiel, 2015; Vaughan, 2015). This is a significantly small number as the government has stated that at least 30 wells must be drilled before the true potential for shale gas production in the UK can even be determined (Vaughan, 2015). Future production wells are highly likely to be constructed in the same region or even at the same site as these exploratory gas wells. Cuadrilla, for example, proposes to drill four of its new wells at its Preston New Road site and four at its Roseacre Woods site. This is due to the fact that many planning and permitting issues associated with the production phase of operations have already been solved at these locations through the exploratory operations

(BGS, 2011a; Deller & Schreiber, 2012). Knowing where the current exploratory sites are located thus allows for predictions about the future siting of commercial shale gas operations and the general location of communities that will be surrounding such sites.

The majority of these existing wells are located in rural or suburban areas, making them similar to those in the US. This trend is expected to continue as rural areas are typically under-developed and have smaller political constituencies, which essentially makes it easier for corporations to grow their operations in these areas, as opposed to urban centers where land is limited and the close proximity of residential housing and public facilities such as schools and hospitals creates heightened risks for their operations (Lipscomb, Wang, & Kilpatrick, 2012; Weber, Geigle, & Barkdull, 2014). Current wells are also located largely in the North West region of England, an area noted for having suffered significant loss during the recent economic recession due to its industrial and manufacturing based economy (Elliott, 2010; Froud, Johal, Moran & Williams, 2012). As of September 2014, the 7.4 % unemployment rate of the North West region was well above the 6.2% average for Great Britain (ONS, 2014).

Many of the extraction companies also claim that their exploratory wells are located in areas that already house a resource extraction industry. Cuadrilla, for example, claims that its Banks well site is located within sight of a former oil field that was successfully operated from 1939 to 1965 (Cuadrilla, 2015a). Third Energy states to already have a productive conventional natural gas field established at Kirby Misperton, where they have recently drilled their KM8 shale gas well (Third

Energy, 2014). This is another notable commonality between US and UK extraction communities as many US municipalities currently housing shale gas operations previously housed other types of mining and extraction industries. This is of little surprise as researchers have established that a poor local economy and former experience with the resource mining industry are both factors that make communities more likely to house a shale gas industry and to accept the risks associated with such activity (Apple, 2014).

In contrast to the growing North West shale industry, two exploratory wells proposed by the European resource extraction company, Celtique Energie, have been rejected by the West Sussex county council in South East England (Gosden & Shiel, 2015; Vaughan, 2015). The planning application for one of these wells, located at Widsborough Green, is currently on appeal due to concerns held by the energy company that the decision criteria were “fundamentally unsound” (Celtique Energie, 2014). Obtaining approval for shale gas exploration may be difficult in this South East region of England that has seen comparatively greater economic success in recent years than the rest of Great Britain (Elliot, 2010; ONS, 2014). The overall prosperity of England’s South East can be seen in the fact that it enjoys an unemployment rate of just 4.8% and claims the lowest number of welfare claimants in the region (ONS, 2014). Although the region is already home to some conventional gas operations, the South East demonstrates low need for the perceivably riskier shale gas operations to generate economic activity due to the success of its current industries. Thus, the local government and communities have

little reason to accept the risks associated with unconventional gas activity and possess the resources to reject proposals for shale gas operations.

One important difference to note between UK and US municipalities is population density. The UK in general has a higher population density than that of the US; England and Wales alone have an average population density of 371 people per square kilometer (ONS, 2011). The best US example of what effect this high population density could have on the way UK communities are impacted by shale gas development can be seen in the Pennsylvania Marcellus Shale region. According to the 2010 Census, Pennsylvania maintains a population density of about 283.9 people per square mile, which would equate to about 109.6 people per square kilometer (U.S. Census Bureau, 2015). This is a rather high population density as compared to other US shale regions. Studies conducted on Pennsylvania's Marcellus Shale Play note that the area's higher population density and less sparsely located municipalities have led to less pronounced population shifts for the region in comparison to its more rural shale counterparts.

The number and close proximity of urban municipalities throughout Pennsylvania have proven to make commuting between drill sites and residential areas easier for drill workers (Schafft, Glenna, Green & Borlu, 2014). This means that in certain instances workers can maintain residency in larger metropolitan areas and simply commute to the drill site during the day rather than trying to find housing in the smaller, more rural communities directly surrounding the well site. As a result, these local communities experience smaller, less drastic population shifts and less residential instability. This trend may also be seen in the UK due to

the fact that the nation's population density is even higher than that of Pennsylvania and the current shale gas exploratory regions possess many urban centers within commuting distance of each other. The average national commuting time for the UK as of 2013 was approximately 41 minutes, with a notable increase in the number of 'super commuters' or workers traveling more than 90 minutes to get to work (Massey, 2013). The commuter population could potentially alter the way UK communities are impacted by the growth of the shale gas industry as social impacts depend largely on worker population and community structure (Kaylen and Pridemore, 2013; Remington, 2013).

Identified Potential Shale Gas Communities in the UK

Cuadrilla currently has four identified shale gas well sites, two of which are still in the planning phase at the time of this writing and thus have not yet been constructed. These wells are concentrated in the Blackpool region of North West England and typically appear to be surrounded by sparsely populated agricultural land. The site maps provided by the company website along with a general satellite map of the region have facilitated identification of the surrounding communities that could see impacts from these wells. The towns surrounding these well sites are numerous and vary in size and composition; in order to maintain the focus of this paper, just a few of these towns will be examined. This thesis seeks to examine communities of varying sizes and compositions in order to maintain the comprehensive scope of this study and ensure that the predictions do not merely reflect potential impacts for one type of municipality. Table 5.1 below provides a

brief overview of each community discussed and the general characteristics of the localities. Figure 5.1 exhibits a locator map identifying the various shale gas regions on which figures 5.2- 5.6 will focus in detail later in this chapter.

TABLE 5.1 Identified UK shale gas communities. Displays the population, unemployment rates, local industries, and nearby well sites of each municipality discussed in this chapter.

Town	Population	Unemployment Rate	Nearby Well Sites (Vaughan, 2015)	Major Local Industries
Elswick, Lancashire	1200 (Moor, 2008)	7.2% (ONS, 2014)	Cuadrilla's Elswick & Roseacre Wood	Agriculture (Moor, 2008)
Blackpool, Lancashire	141,400 (ONS, 2014)	8.8% (ONS, 2014)	Cuadrilla's Preese Hall & Preston New Road	Tourism, Manufacturing, (Blackpool Bay Area Co., n.d.)
Salford City, Greater Manchester	237,085 (IN Salford, 2014)	9.3% (ONS, 2014)	IGas' Barton Moss	Service sector, Retail, Digital communications (IN Salford, 2014)
Ellesmere Port, Cheshire West and Chester	9,103 (Strategic Intelligence Team, 2014)	4.1% (Strategic Intelligence Team, 2014)	IGas' Ellesmere Port & Ince Marshes	Manufacturing, Oil refining (Strategic Intelligence Team, 2014)
Kirby Misperton, North Yorkshire	370 (Kirby Misperton Parish Council, 2015)	4.6 % * (ONS, 2014)	Third Energy's KM8	Agriculture (Kirby Misperton Parish Council, 2015)

* Unemployment rate for North Yorkshire

** Unemployment rate for Lancashire

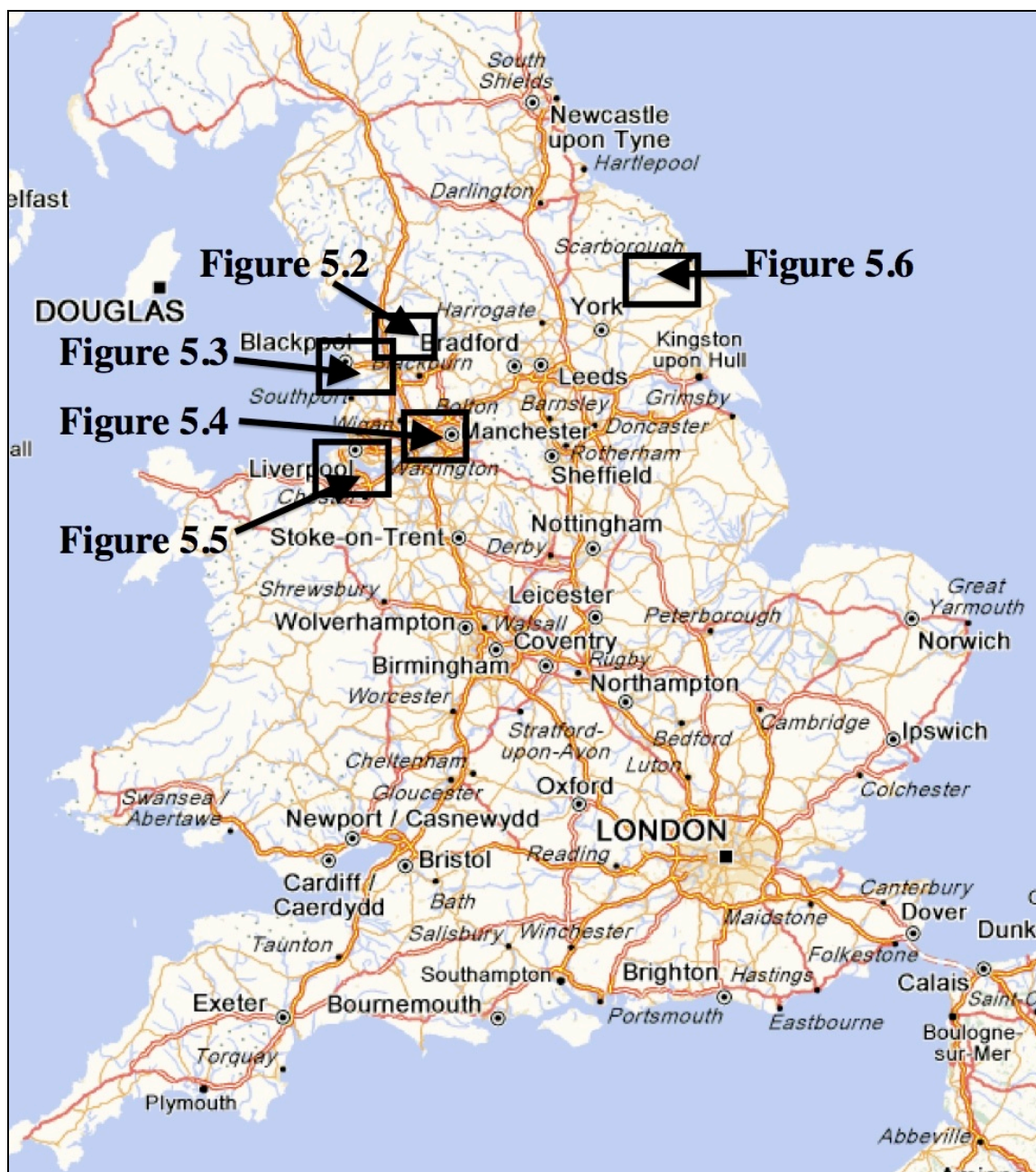


Figure 5.1 Shale gas community locator map. shows the various locations on which figures 5.2, 5.3, 5.4, 5.5 and 5.6 will focus in detail.

There are various small towns dotting the rural landscape around these UK exploratory wells, of which Elswick will be the first examined in this paper. Cuadrilla hydraulically fractured a gas well in Elswick in 1993 and has since been successfully using the well to generate electricity. I have found no literature on the impacts that this operation has had on the community, although Cuadrilla claims that the site is barely even noticeable to residents and passers-by (Cuadrilla, 2015a). The town could see additional impacts from fracking operations as it is also located near the Roseacre Woods site, where Cuadrilla has proposed to develop a shale gas well to be fracked and flow tested sometime in the near future (Cuadrilla, 2015a). The location of these wells in proximity to the town of Elswick are displayed in figure 5.2.

Elswick, like many of the other small towns in the region, boasts rural roots and maintains a relatively small population of around 1200 people. Elswick claims to be “a modern dormitory village, offering a home for residents looking for a quieter, more peaceful lifestyle”. The Elswick Parish Council’s website states that, though the main industry for the village is still agriculture, an easy commute to larger cities such as Blackpool and Poulton-le-Fylde mean that local farming is no longer the town’s largest employer (Moor, 2008). This implies that many of the small towns in this region that are located within reasonable commuting distance to the more major metropolitan areas serve as residential communities for urban workers who wish to live outside the city. The commuter population of these communities is important to note as it could affect the level and type of social impacts the town may see in the event of a shale gas boom.

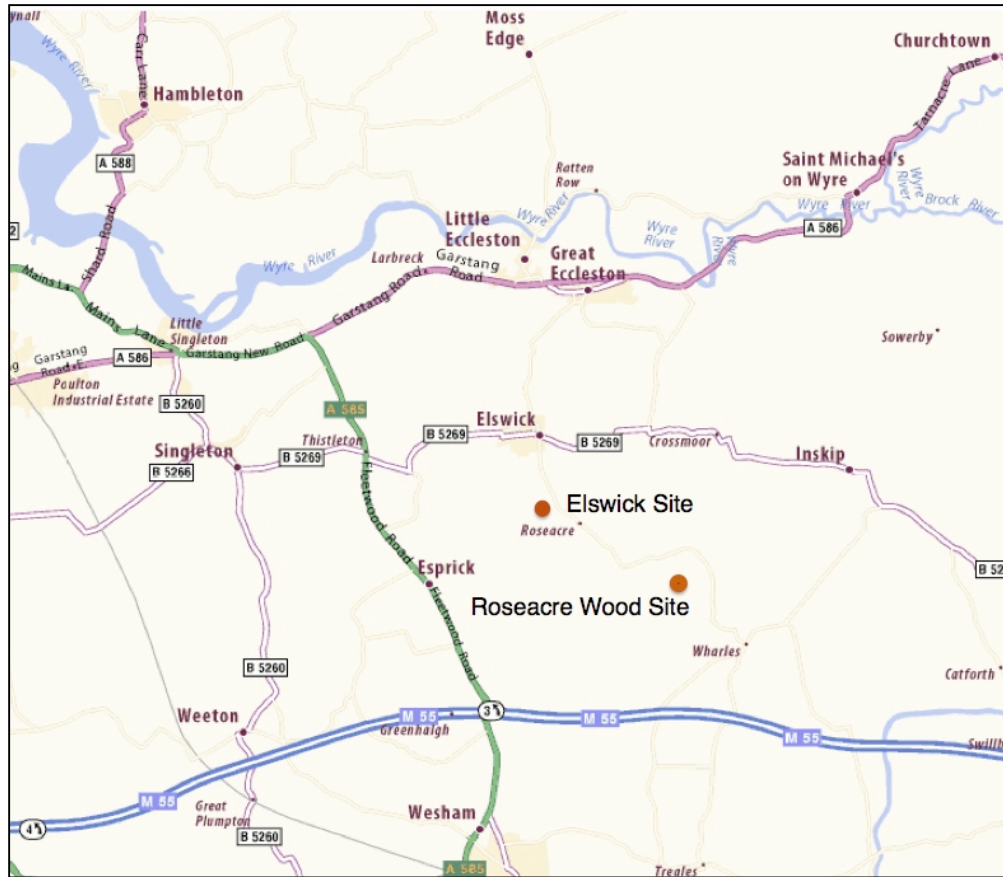


Figure 5.2 Elswick map. Shows the two well sites owned and operated by Cuadrilla which are located in close proximity to Elswick (Base map: Michelin Map of United Kingdom).

One major city that could see impacts of the North West region's growing shale gas industry is Blackpool, along with its surrounding areas of South Shore and Poulton-le-Fylde. As seen in figure 5.3, Blackpool is in close proximity to the Preston New Road well site that Cuadrilla has recently proposed to frack and flow test for shale gas production capabilities (Cuadrilla, 2015a). It is also within several miles of the Preese Hall well site that gained so much attention from government and media after inducing two small earthquakes during a fracking operation in 2011. The Preese Hall site itself will likely not pose any future impacts for Blackpool, though,

as it is to be sealed and returned to its original condition instead of seeing further development (Cuadrilla, 2015a).

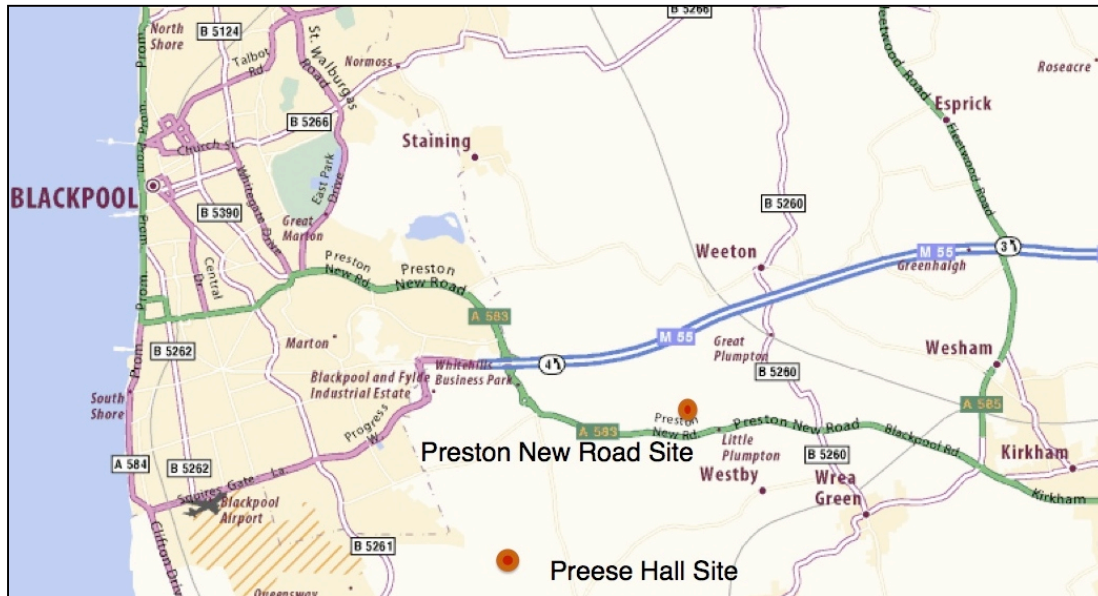


Figure 5.3 Blackpool map. shows the location of the Preese Hall and Preston New Road well sites operated by Cuadrilla in proximity to the city of Blackpool (Base map: Michelin Map of United Kingdom).

The current state of Blackpool's residential community is important to note as it already exhibits many of the social ills characteristic of the boom-bust cycle induced by the growth of the mining industry. Blackpool has been labeled the most unhealthy city in the UK, with alcoholism and cigarette smoking among the main culprits of health problems. There is also a lack of adequate housing in this city of approximately 140,000 people, with houses of multiple occupation (HMOs) growing in number. Poverty is another major social issue for the city, according to Blackpool Director of Public Health, Dr. Arif Rajpura, as the city tends to attract the poor and ill from outside areas. The local government claims that the city has a turnover rate of about 7,500 people per year, with a higher number of benefit claimants entering the city than leaving it (Collinson, 2013). It is important to note the current social and

economic struggles of Blackpool as it fits the description given in chapter one of a municipality at risk of morphing into a boomtown should it accept shale gas industry operations in its region.

Greater Manchester is another major urban center that could see potential impacts from the development of the shale industry, specifically within the Salford City region. In 2010, the Salford City Council approved an application by IGas to drill an exploratory well at Barton Moss. Figure 5.4 shows the location of IGas' Barton Moss well site in relation to the city of Salford. Exploratory operations have since been completed and activities at the site have been suspended until lab results can determine the viability of the well (IGas Energy, 2014a). This means that Salford could potentially see further shale gas development for commercial production within their locality. Salford is home to 8,200 businesses employing over 130,000 people, and has the second highest predicted growth rate of all greater Manchester. Although historically a very industrial and manufacturing based municipality, today Salford boasts a diverse, service-based economy comprised of digital communications, financial and professional services, and construction businesses (IN Salford, 2014). Mining and quarrying currently make up only .1% of the Salford economy. Despite the apparent success of the local economy, Salford has an unemployment rate of 9.3%, well over the national average of 4.4% (ONS, 2014).



Figure 5.4 Salford City map. shows the approximate location of the Barton Moss well site that could impact the nearby Salford community (Base map: Michelin Map of United Kingdom).

IGas's other two shale gas well sites are located near the much smaller community of Ellesmere Port in the Cheshire, England area. The location of the Ellesmere Port and Ince Marshes well sites in respect to the town are shown in figure 5.5. Ellesmere Port is an industrial town claiming a population of 9,103 people and 9,068 households. It is located on the Manchester ship canal and currently houses an oil refinery, a chemical works plant, and a car factory. As of 2011, Ellesmere Port enjoyed an unemployment rate of just 4.1% (Strategic Intelligence Team, 2014). The area is currently home to a notable coal bed methane extraction industry, to which IGas has added two exploratory wells within just a few miles of each other since 2011 (IGas Energy, 2014a). This further supports previously mentioned research stating that communities which have already accepted mining industries in the past are apt to accept the introduction of a shale gas industry in their locality as well.

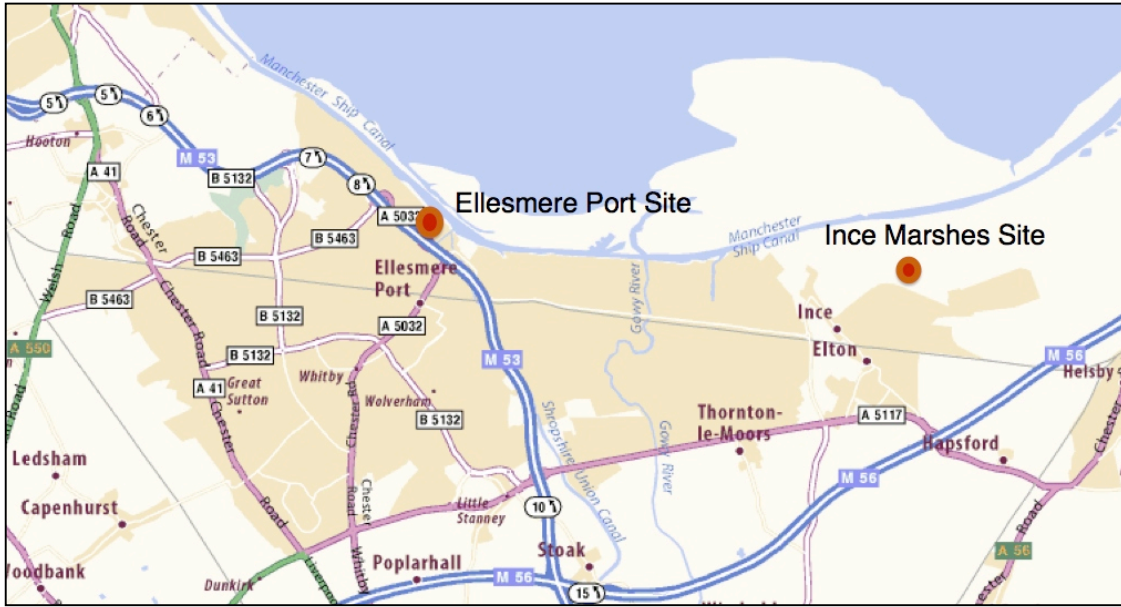


Figure 5.5 Ellesmere Port map. displays the location of IGas' two well sites that may have social impacts on the Ellesmere Port community (Base map: Michelin Map of United Kingdom).

Third Energy's KM8 shale gas well site sits within an existing conventional gas field operated by the company at Kirby Misperton in the North Yorkshire region of England. The approximate location of this well site is shown in figure 5.6, although the exact location of the well was not provided by Third Energy's website description of the well site. The small village of Kirby Misperton covers approximately 1,784 acres, hosts 370 residents and has 159 households. The community webpage lists a host of hotels, construction companies, and farms as the local businesses implying that the community relies largely on its agriculture industry (Kirby Misperton Parish Council, 2015). The small town is approximately a 45 min drive from both of the neighboring cities of Scarborough and York. This makes it probable that, like the residents of Elswick, many of the residents of Kirby Misperton commute to these urban centers for work. As mentioned earlier, this close proximity and feasibility for daily travel between locations is important to take

into consideration as the worker population of shale gas communities has a significant impact on the social impacts seen by those communities. It possible that growing shale operations around Kirby Misperton will also have social impacts on York and Scarborough; just as workers commute from rural areas to the city, the reverse could also be true.

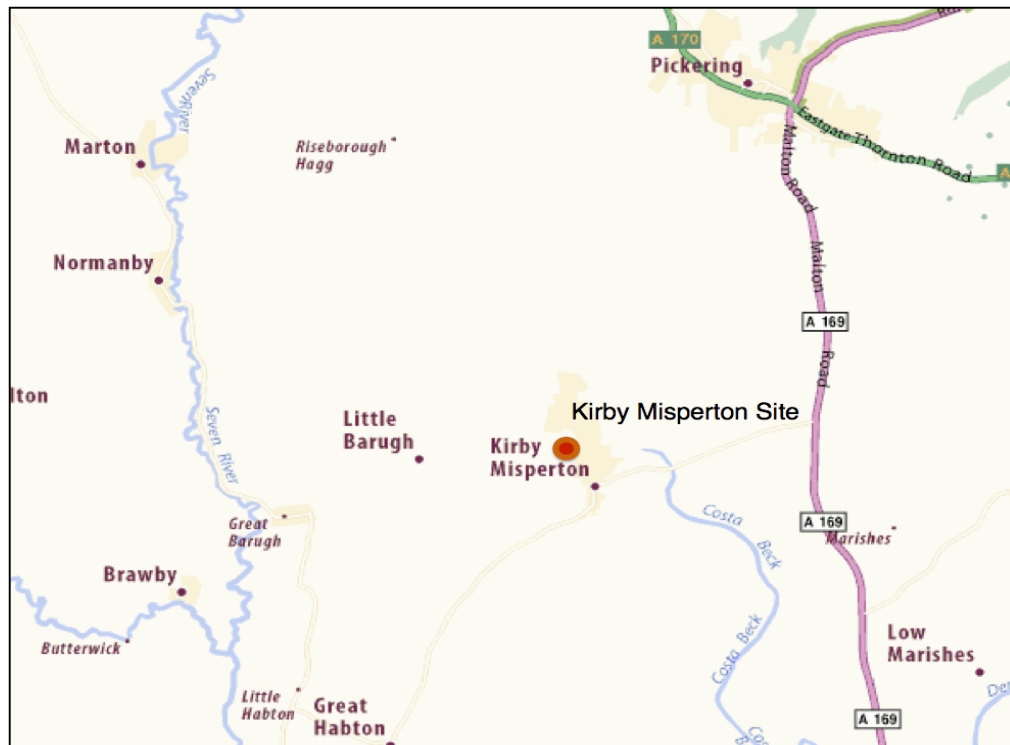


Figure 5.6 Kirby Misperton map. shows the approximate location of the KM8 well site at Kirby Misperton (Base map: Michelin Map of United Kingdom).

Third Energy has already boasted of the potential community benefits that could come from accepting their planning application for the KM8 well. Their website states that “Third Energy is committed to sharing the benefits from our activities with the local community; either directly through increased employment or through the opportunities for local businesses to benefit from supplying goods and services for our operations.” They also make note of the £100,000 in community

benefit payments that will be made upon approval of the planning application, along with the 1% of gross revenues that would be granted to the community upon commercial production. Third Energy estimates that if the well is able to successfully produce shale gas, it could lead to a monetary benefit of about £70 million to the local community over a 20 year time period. The company also offers assurances that the visually unobtrusive nature of their work will leave the local tourism industry unaffected by the development of a shale gas well (Third Energy, 2014).

These UK communities exhibit much of the same general make-up, location and socioeconomic status as those surrounding well sites in the US. They are largely located in rural regions that have limited resources for developing their economy, and many of the communities have already had experience with mining industries in the past. This makes it likely that the communities will experience many similar impacts in the event of a UK shale gas boom. Variations in the social impacts may arise, though, due to the difference in population density and commuter tendencies between US and UK communities. The potential social impacts that a shale gas boom could have on UK communities will be explored in detail within the following chapter.

Chapter 6

Environmental Justice

Chapter 5 considered the variable social impacts that fracking can have on different types of communities. Chapter 6 take a closer look at some of these social impacts through the lens of environmental justice. Poor, rural, and minority communities tend to be disproportionately impacted by the environmental and social impacts of resource mining, which raises the issue of environmental justice in the resource extraction process (Gouldson, 2006; Noonan 2008; Scholsberg, 2013; Weber, Geigle, & Barkdull, 2014). Environmental justice (EJ) is defined as “the fair treatment and meaningful involvement of all people – regardless of race, colour, national origin or income – in the development, implementation and enforcement of environmental policies”. This turns the environmental issues associated with fracking and resource mining into social and human rights issues as well (Gouldson, 2006).

As noted in previously mentioned research on uncontrolled development scenarios, economically deprived communities often lack the ability to mitigate the impacts of the extraction industry in their region (Apple, 2014; Gouldson, 2006). The communities are often excluded from decision-making processes, which leaves them being disproportionately impacted by the negative effects of resource

extraction. Research on toxic substance release and pollution has revealed a correlation between lower levels of environmentally friendly practices by corporations and lower levels of income per capita and higher unemployment rates in surrounding communities (Gouldson, 2006). This does not necessarily prove a causation, but the link between these two scenarios raises questions about the protections provided to less privileged communities and the extent to which they have the same opportunity as wealthier communities to safeguard their health and livelihoods from the negative impacts of industry development.

The environmental justice movement focuses on providing both equitable processes for the distribution of environmental hazards and equitable outcomes of the distribution. Disadvantaged communities in the US have been able to organize under the environmental justice movement to gain compensation for the harms they have experienced due to practices and policies regarding environmental hazards (Noonan, 2008). Proponents of environmental justice argue for these communities to have an equal voice in the conversation about what types of environmentally hazardous activities, such as fracking, may be allowed in their area and claim that there is a need for more equitable distribution of hazards between wealthy and disadvantaged neighborhoods (Noonan, 2008; Scholsberg, 2013). The US government has taken note of this growing movement and in response the Environmental Protection Agency (EPA) has adopted new policy in which it has pledged “equal protection for all populations” in regards to environmental hazards (Gouldson, 2006). This government action is a testament to the fact that EJ issues

are gaining increasing importance in society and becoming a larger focal point of industry development processes.

Environmental Justice in the UK

The EJ movement has grown substantially in recent years from revolving around individuals and communities in the US to applying to communities around the world (Scholsberg, 2013). Elements of the EJ movement can be seen in the UK shale gas development process through the perceived inequity in the distribution of risks and benefits from shale gas production and the lack of community inclusion in decision-making processes. Shale gas development thus far is concentrated in the North and North West of England, two regions that have suffered greater economic hardship through the recession than the remainder of England (Elliot, 2010; Froud, Johal, Moran & Williams, 2012). This is an example of economically deprived regions suffering disproportionate susceptibility to environmental harms, making the distribution of these well site appear on some level to be a form of environmental injustice.

It should be noted, though, that a lack of information on why unequal distribution occurs in the first place makes injustice difficult to accurately label and address. Although there is substantial literature on the effects and evidence of environmental justice and injustice, there is a lack of research on the issues of why and how this injustice takes place (Noonan, 2008). Proposed reasons range from white flight leaving communities of minorities living near environmental hazards to industry and government choosing to site hazards near poor communities because

they seek the path of least resistance (Noonan, 2008; Scholsberg, 2013). In order to label a situation as environmental injustice, there must be some evidence of unjust processes leading to the disproportionate allocation. In the UK situation, the placement of wells could simply be attributed to the fact that the North West is home to the UK's largest shale play, the Bowland Shale Play. Thus, the disproportionate placement of well sites could be a result of the concentrated location of resources rather than distributive or procedural injustice. Further research would need to be conducted on how well sites are chosen in order to truly determine whether the concentration of shale gas activity in the North West is the result of environmental injustice.

Regardless of regional placement, though, there is also evidence of disproportionate distribution of risks and benefits from shale gas development. Communities surrounding well sites will bear the main impact of any social and environmental harms resulting from extraction activity. Meanwhile, the extraction companies and government will be the main recipients of industry benefits. This creates a form of inequity as those who are positioned to deal with the largest portion of risks are poised to receive a mere 1% of the benefits. Questions of participatory justice also arise when determining whether stakeholders have the ability to take part in decision-making processes about development that could affect them. Participatory justice is a significant component of EJ, which involves granting stakeholders a place at the table and allowing them to advocate for themselves during decision-making (Scholsberg, 2013). A lack of participatory

justice means that community residents are not benefitting from an equal say in the discussions and decisions leading to the distribution of industry risks and benefits.

Implications of the EJ Movement

Many UK-based environmental organizations, such as Friends of the Earth, have adopted environmental justice as a major facet of their agenda supporting the just distribution of environmental harms. Even government agencies seem to be taking account of the need to address EJ issues, as is evidenced by the commissioning of studies on the distribution of environmental harms throughout the UK and the development of regulatory policy that involves EJ ideals (Institute for Environment, Sustainability, and Regeneration (IESR), 2003). The Environmental Agency (EA), which is one of many agencies regulating shale gas development, has recently amended its Sustainable Development Strategy (SDS) to include the promotion of environmental justice in communities throughout the nation (Gouldson, 2006). The EA's most recent revision of SDS includes goals such as the development of "sustainable communities" that are "active, inclusive, and safe" as well as "fair for everyone" and provide living arrangements that are environmentally sensitive (Department for Environment, Food & Rural Affairs (DEFRA), 2005). These aims are rather vague, but they are reminiscent of environmental justice values of promoting sustainability, fairness, and inclusion of stakeholders. These regulatory goals are a first step toward government promotion of environmental justice in UK communities.

The push for environmental justice could have impacts on the siting of shale gas wells in the UK and the ability of corporations to utilize hydraulic fracturing near certain communities in the future. The regulation of corporations by government depends heavily on the struggles that exist between the corporations and their stakeholders. As such, corporations need a type of social license to operate successfully and without interference from stakeholders or government (Gouldson, 2006). This social license entails the acknowledgement of stakeholders of the legitimate and acceptable nature of the corporation's actions. In the UK shale gas scenario the stakeholders would be communities and residents who could be affected by industry activity.

The UK government has acknowledged that there must be public acceptance before onshore shale gas can develop and grow into a profitable industry (EAC, 2014). This public acceptance is closely linked to environmental justice issues because fairness and equity are major proponents of each. Acceptance has yet to be achieved in the UK due to widespread public fear over the risks of hydraulic fracturing and doubt over the accountability of drilling corporations. The UK public also seems to be of the opinion that the distribution of well sites and the procedures for determining acceptable levels of industry activity do not allow for the adequate involvement of community stakeholders. Recent policies such as the previously mentioned 2013 Town and Country Planning Order, which grants extraction companies the right to carry out subsurface drilling activities without notifying the property owner, and the 2014 Infrastructure Bill, which gives companies the right to extract resources from subsurface land without property owner approval, only

add to the lack of inclusion and equity for community residents in shale gas development (White, Fell, Smith & Keep, 2014). This legislation takes away the rights of landowners to have a say on activities that could have long-term effects on their property and livelihoods. This lack of participatory justice and perceived distributive and procedural fairness exhibits how environmental justice issues are serving as a significant roadblock to the granting of social license to operate in the UK shale gas industry.

Shale gas development regulations currently attempt to address this issue by providing for a standard community feedback period during the planning application process in which residents can put forth their concerns over or support for industry development. This allows for stakeholder involvement in the decisions process and, thus, is a small step toward addressing the procedural fairness and participatory justice components of environmental justice (Cotton, Rattle, & Alstine, 2014). Concern amongst the public remains, though, over whether their opinion has as great an influence over planning authority decisions as the government and industry monetary incentives to support industry growth. There has been widespread acknowledgement by the media that the public believes industry needs are being given greater priority by government than the rights of individuals and communities. The monetary incentives offered to local governments through the proposed community benefit schemes are seen by some residents as a form of bribery, making government officials more partial to industry requests than resident needs (Cotton, Rattle, & Alstine, 2014). This marginalization of public opinion by UK government has created perceptions of inequity in the decision

making process and facilitated public distrust of both government and industry. This has given rise to many of the protests and public pushback against industry growth (Robertson, 2014).

Thus, a significant portion of the pushback that UK shale gas development is receiving from communities and local organizations is the result of perceived environmental injustice. If EJ concerns are not addressed by the UK government, it could see even greater pushback from the public in regards to shale gas development in the future as the EJ movement is positioned for growth. This could slow industry development and lead to the creation of additional EJ focused regulations in the future. The UK government itself has ceded that even incentives such as local benefit schemes will not prevail in driving industry growth if public concerns about perceived harms are not addressed (EAC, 2014). The public must see corporate actions as justified and producing fair results for stakeholders before they grant the company a social license to carry out their operations; instead they have seen exclusion from decision making processes, perceived violation of their rights as property owners, and stand to see greater damage than benefit from production activity. There must be a movement toward greater consideration of stakeholder concerns and more equitable distribution of the harms and benefits of shale gas development before public acceptance will be granted in the UK.

Chapter 7

Predictions

This chapter explores how previously mentioned practices and characteristics may combine with a shale gas boom to potentially impact UK communities. I will first summarize the conditions necessary for a boom-bust cycle to occur, and then give a brief overview of current conditions present in the UK. I will then go on to make predictions about what social impacts UK communities may see during both the boom and bust cycles based on the conditions and characteristics present in UK communities and the experiences of US communities. The social impacts on communities in the UK are likely to have some similarity to those in the US, but may differ due to differences in regulation, the rights of property owners, population densities, and commuter practices between the two countries (Redacted & Rural Community Policy Unit, 2014). The UK government may also be able to avoid some of the negative impacts seen in the US through more comprehensive regulation and the consideration of risks at an earlier stage of development.

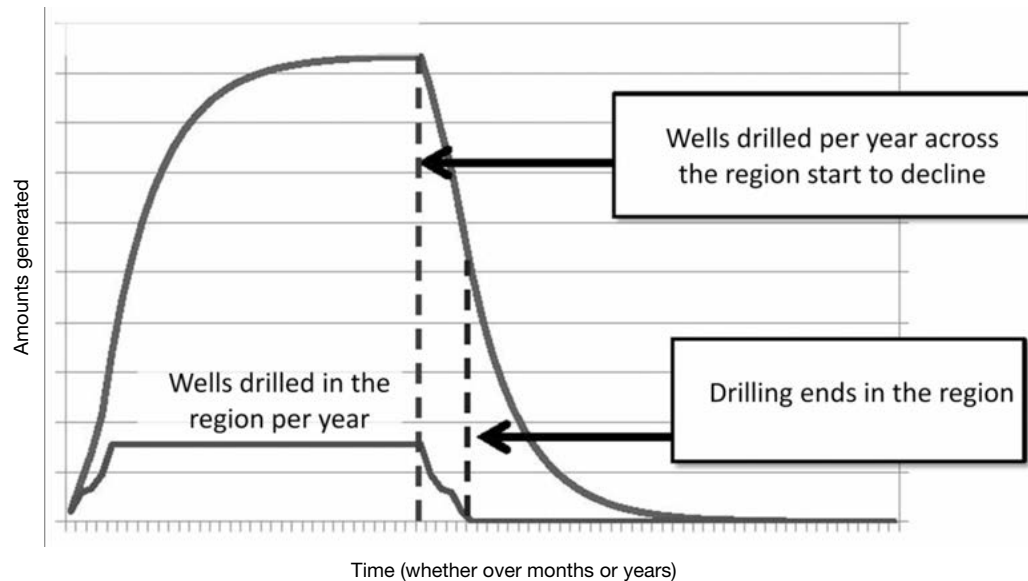
The Boom- Bust Cycle

As mentioned in chapter one, the boom-bust cycle is a characteristic product of mining industry growth and decline; thus, it has accompanied the shale gas boom in the US and is a predictable outcome of a future shale gas boom in the UK. A boom cycle is characterized by the rapid growth of the extraction industry, which leads to a sudden influx of jobs and capital within those localities hosting drill sites. This growth of industry tends to push out other major local industries while growing those service sector businesses that cater to the mining industry and its worker population; this leaves the locality highly dependent on the extraction industry for jobs and capital (Christopherson & Righor, 2011; Deller & Schreiber, 2012). This over dependence sets the conditions for a bust cycle once the resources have been depleted and the extraction industry moves out.

The boom cycle is also characterized by a significant influx of mining industry workers into local communities surrounding drill sites. This sudden increase in population serves as the catalyst for many of the social impacts inherent of a boom-bust cycle. Housing prices rise as demand grows and supply is limited, which can force some permanent local tenants to leave the locality and yield their residencies to the growing migrant worker population (Christopherson & Righor, 2011; Lipscomb, Wang, & Kilpatrick, 2012). The lack of adequate housing creates substandard living conditions and can give rise to price gouging, increased homelessness, and the establishment of crowded man camps within the locality (Schafft, Glenna, Green, & Borlu, 2014; Weber, Geigle, & Barkdull, 2014).

Once all resources have been extracted and the well site is no longer productive, the extraction industry moves out, taking its worker population with it. This sudden loss in jobs and capital can prove detrimental to the local community as the service sector built up during the boom cycle is no longer sustainable and all other business sectors were crowded out by the extraction industry (Apple, 2014; Christopherson & Rightor, 2011). The population plummets as the worker population moves out, along with many others who can no longer make a viable living in the region due to the tanking local economy. These boomtowns typically become poorer after the bust than they were before extraction activity was even begun (Christopherson and Rightor, 2011; Deller & Schreiber, 2012; Weber, Geigle, & Barkdull, 2014). This boom-bust pattern in relation to regional drilling activity is illustrated in figure 7.1.

The pattern of the Boom-Bust cycle in royalties, business income, tax revenues and jobs



Adapted from Tim Kelsey (2011), 'Annual Royalties in a Community'.

Figure 7.1 Boom- Bust cycle pattern. Exhibits the rise and fall in revenues and jobs generated for local communities in relation to the life cycle of a typical oil or gas field within the region. The chart illustrates how the decline in drilling activity causes a sharp drop in local jobs and revenues, and how even after drilling ends the community continues to experience decline (Christopherson and Rightor, 2011).

Boom-Bust Cycles in the UK

In the UK, there has been no sign of this boom-bust cycle resulting from shale gas industry growth thus far. This is due in large measure to the significantly slow growth rate of the industry to date. The size and extent of a boom cycle is dependent upon the scale of drilling operations and the pace at which they are carried out (Christopherson and Rightor, 2011). Despite backing by the UK government, the industry has seen “glacially slow” growth rates compared to those of the US and other nations around the globe (Vaughan, 2015). The UK-wide moratorium on

fracking from 2011 to 2012 and the more recent moratorium imposed on all unconventional oil and gas planning consents by the Scottish Parliament in January 2015, along with notable concerns and pushback on behalf of local government and communities have done much to mitigate the growth of the shale industry in the UK (EAC, 2014; *The Economist*, 2015).

The boom-bust cycle is not a new phenomenon to the UK as it has previously experienced this in industries such as coal mining and shipbuilding, and is currently seeing this in the offshore oil industry. Due to the fact that the boom-bust cycle has similar impacts across all sectors of resource mining activities, it can be helpful to look at the offshore oil industry and its impacts on Aberdeen, Scotland as an indicator of potential impacts of the developing shale gas industry. Aberdeen has been named the energy capital of Europe due its prominent position in the oil industry, which began in the 1960s. The city had previously seen the rise and fall of several other major industries, such as granite quarrying, shipbuilding, and fishing, but had long been in a period of decline by the time that the North Sea Oil industry took off (IoD, 2013). The majority of North Sea Oil operations run out of Aberdeen, and the city has experienced significant growth and economic development due to the presence of these operations. The oil and gas industry, along with its supporting service industries, account for approximately 60% of employment in the Aberdeen city region. The city also hosts 18 of the nation's top 50 companies, and the highest concentration of millionaires in the UK (Geoghegan, 2014; IoD, 2013). In addition, it is the world's busiest heliport due to the sheer number of transports required to carry workers to and from well pads during operations.

Economic growth and increased air traffic have not been the only result of the oil boom in Aberdeen, though. Traffic on the ground, a problem common to shale gas boomtowns in the US, has also seen a significant spike and congestion has become a major issue for the municipality (IoD, 2013). As Aberdeen has become a very desirable place to live, housing rents have also skyrocketed within the city with monthly rent averaging around £1,000 (Geoghegan, 2014). This is another boomtown affect common to US shale gas communities and likely to occur within UK shale communities as well. The significant rise in the cost of living in Aberdeen has been noted as a major cause of poverty in the local community, and the city has seen a dramatic rise in the demand for food banks in recent years (Geoghegan, 2014).

Recently, the decline in North Sea Oil production has caused major cutbacks in the UK oil industry, including the layoff of many offshore workers. This bodes ill for the city of Aberdeen as its economy is so highly dependent upon oil industry operations and there is still question as to whether the municipality has the resources to successfully transition from oil and gas to other more sustainable industries (Geoghegan, 2014). Many have cited this as the beginning of the bust cycle for North Sea Oil, and it will be beneficial for government and potential shale gas communities to pay attention to the impacts this has decline has on Aberdeen. Bust cycle impacts experienced by this city are likely to be highly similar to future bust cycle impacts seen by cities that form high dependency on shale gas operations.

In determining the extent of boom-bust cycle impacts, it is also important to note that the UK stands to see a much smaller proportion of jobs and capital

generated by the unconventional oil and gas industry than the US. It has been widely agreed upon by industry and government officials that shale gas in the UK will not be the significant 'game-changer' that it was in the US (*The Economist*, 2015; White, Fell, Smith & Keep, 2014). This means that if the industry does manage to take off, its boom would be marginally smaller than that seen in the US (EAC, 2014). One prediction offered in 2013 stated the UK shale industry could generate £3.7 billion per year in investments and employ approximately 74,000 people (Redacted & Rural Community Policy Unit, 2014; White, Fell, Smith & Keep, 2014). Research conducted on the unconventional oil and gas industry in the US, though, tells us that these initial predictions are typically over-optimistic and the reality of employment is often much lower than promised by industry input-output analyses. The Pennsylvania Marcellus Shale, for example, was projected to provide 48,000 jobs through industry growth; but the reality is that state employment data shows only 9,300 additional jobs created in the region since the initial shale oil and gas boom in 2007 (Christopherson and Rightor, 2011).

The UK shale gas industry is also likely to be dependent upon overseas workers during its initial development stages, which would limit the number of local jobs provided for in shale gas regions. This is due to the current lack of skilled workers and service providers within the UK that are able to sustain the shale gas industry (Ernst & Young, LLP, 2014; IoD, 2013). Approximately 75% of offshore oil and gas operators currently report trouble recruiting skilled workers. This problem is likely to be just as prevalent in the emerging shale gas industry due to the UK's overall lack of experience in this field (IoD, 2013). UK workers will have to be

trained and the industry will have to grow enough to merit the development of an adequate local supporting service industry before jobs can be transferred from overseas specialists to local employees. This trend of recruiting overseas workers to help develop new industry was seen during the development of offshore oil in the North Sea in which 5,000 North American workers were the initial operators of the offshore rigs. Over time, though, as UK workers and businesses developed the necessary skills and services to sustain the industry, the percentage of overseas workers within the industry has shrunk to a minority; this would likely be the case for the emerging shale gas industry as well (IoD, 2013).

Based on the current trends in the UK and the information garnered on boom-bust cycles created by the unconventional gas industry in the US, it appears unlikely that the growth of the UK shale gas industry will occur rapidly enough for significant US-style boom cycle conditions to arise. Research Director Jim Watson of the UK Energy Research Centre predicts that the UK will not have any substantial shale gas industry until the early 2020s (Vaughan, 2015). The slow growth of the industry thus far and the potential for long-term moratoriums and tightening regulations on the industry mean that communities will have a significant amount of time to prepare for and plan to handle the impacts of shale gas industry growth. Ideally, this time could be utilized to take preventative measures to minimize any future negative impacts such as housing shortages, infrastructure deterioration, and the decline of the local economy during the inevitable bust cycle. Local and national governments could collaborate to establish transportation routes for industry supply trucks that would be less disruptive for local travellers, plan for adequate

temporary worker housing within identified shale production areas, and develop a budget to help communities maximize the use of their resources during a boom and minimize the hardships of a shale industry bust (Christopherson and Rightor, 2011). The establishment of road use agreements and the planning and enforcement of truck routes that minimize the damage caused by heavy truck traffic on local roadways is one of the major recommendations made by local governments in already developed shale plays in the US (Christopherson and Rightor, 2011). The UK could learn from the unpreparedness of some US communities and take preemptive measures to mitigate the negative impacts of the boom and bust cycle.

Social Impacts of the Boom Cycle

Even though the boom cycle is likely to be gradual in the UK, some social impacts are likely to occur. The initial economic development, population changes, and housing shortages brought about through the boom cycle serve as catalyst for further alterations in community social norms. The major social impacts brought about by these changes are increased social disruption, changing crime rates, and increased social tensions within local communities. These impacts were described in detail in a previous chapter, but I will provide a brief recap here in order to explain to what extent these alterations may be seen in the UK.

Social disruption.

Social disruption theory claims that the rapid growth of a municipality leads to a loss of community norms, a breakdown in the effectiveness of community services, and ultimately places the community in crisis (Luthra, Bankston, & Kalich,

2007; Weber, Geigle, & Barkdull, 2014). The rapidly fluctuating population can alter local demographics and shift the socio-economic status of the community (Kaylen & Pridemore, 2013). The housing shortage created by the booming population forces some local residents out of the community and replaces them with a growing number of migrant workers; thus, community social networks and neighborhood dynamics begin to change. Local community services are often strained by this sudden population increase as they must serve a larger, more costly client base with the same limited resources (Christopherson & Rightor, 2011; Schafft, Glenna, Green & Borlu, 2014). The efficiency and effectiveness of local services deteriorates due to insufficient funding, lack of social workers and service providers, and a lack of community resources such as housing and childcare (Shandro et al, 2011; Weber, Geigle, & Barkdull, 2014).

In the UK, the level of social disruption that occurs will depend largely on the size and composition of the worker population that develops to serve the shale industry. In the early stages of development it is likely that a significant overseas workforce will be needed to support the industry, and these workers will need to take up temporary residence within UK shale gas communities. This initial influx of foreign workers has the potential to create sizable population booms within UK communities, thus creating the kind of social disruption noted in US communities. The city of Blackpool is well positioned to acquire a large portion of these migrant workers as it is within the most concentrated region of shale gas activity to date and possesses a sizable airport with capacity for expansion as air traffic increases. These are both criteria that made Aberdeen the ideal central hub for oil industry activity in

the 1960s. The Blackpool airport also already serves as a heliport to transport worker to offshore oil rigs in the Irish Sea (IoD, 2013). Lancashire County, of which Blackpool is a city, is also home to an extensive motorway and railway system, which can provide access to well sites across the North West. Thus the city is a prime location for overseas migrant workers who will likely need access to a range of shale gas operation sites during the initial stages of commercial development, as well as an ideal location for service industries that supply the shale gas industry.

As the industry matures, this foreign workforce will likely diminish and there will be a population shift as these overseas workers are replaced by a more localized UK workforce. As noted earlier, the ability of UK workers to commute between drill sites rather than temporarily take up residence in a new locality to conduct extraction operations minimizes the boomtown effect that the growth of industry has within local municipalities (Schafft, Glenna, Green & Borlu, 2014). Due to the proximity of its current well sites and the density and spatial location of UK municipalities, the UK shale industry workforce is well positioned to take advantage of long-distance commuting opportunities. Research suggests that workers are already taking advantage of this opportunity in other industries, thus increasing the likelihood that it will also be a notable trend within the extraction industry (Massey, 2013). This, in turn, could mitigate the social disruption seen within UK communities surrounding drill sites, as they would see substantially smaller fluctuations in population during a boom cycle. The communities may see significant alteration in the daytime population and the local service industry, but would not see the impacts induced by significant housing shortages.

There would also be less change in community service needs within the municipality in the event that a local population boom does not accompany the shale industry boom. Although service workers may still suffer the effects of increased traffic and higher operating costs due to the increased burden that extraction activity has on local infrastructure, there would be no housing crisis and minimal displacement of local residents. Communities may still experience a loss of community norms, though, as a growth in the service industry would still be needed to serve the daytime worker population of the locality. This economic growth combined with the increased industrialization of the region due to growing extraction operations and changes in local infrastructure could alter the every day dynamics of the locality (Kaylen & Pridemore, 2013). If a small, rural town like Elswick, for example, were to experience a significant increase in industrialization, then the whole dynamic of the town would be altered. Instead of coming to live in a quiet, rural 'dormitory village' away from the crowded streets of the urban city center, members of the community would be coming home to a newly industrialized mining town complete with all the noise, dust and increased traffic that comes with extraction operations.

Crime rates.

Social disruption has also been found to have an impact on local crime rates, although it is important to note that these changes are difficult to predict as crime naturally fluctuates in small towns and cannot be standardized across municipalities (Luthra, Bankston, & Kalich, 2007). Poverty, increased ethnic diversity, residential instability, and family disruption are all direct results of social

disorganization; they are also all factors leading to increased crime rates within a locality (Kaylen & Pridemore, 2013). As discussed earlier in this paper, increased mining activities in the US have been linked to a decrease in violent crimes such as homicide and aggravated assault for surrounding communities. The rapid population growth during the boom cycle, though, has been linked to an increase in property crimes such as robbery, burglary, and larceny (Luthra, Bankston, & Kalich, 2007). The loss of social networks due to the rapidly shifting population also creates a lack of accountability and guardianship within neighborhoods. This means that residents have greater difficulty in identifying community threats and are less likely to protect each other from victimization (Kaylen & Pridemore, 2013). This loss of informal controls on local crime can lead to both increased fear of crime and an increase in crime itself (Luthra, Bankston, & Kalich, 2007).

Social tensions.

Increased social tensions are another result of the boom cycle, brought on by polarization of opinions in the community regarding resource extraction issues. Social tensions are generally created by the emergence of a haves v. have-nots community divide, with those receiving direct benefits from the presence of a mining industry supporting industry activities and those experiencing the costs with no direct benefit opposing industry activity. In the US this divide is typically drawn between landowners and non-landowners. This is due to the fact that those who own both property and mineral rights benefit the most from extraction activity, while those who do not see only the negative costs of industry activity borne by the

community as a whole (Apple, 2014; Jacquet, 2012; Lipscomb, Wang, Kilpatrick, 2012).

This phenomena will undoubtedly be drastically different in the UK than it is in the US due to Crown ownership of all mineral rights and the absence of royalty payments to individual landowners in the UK (EAC, 2014; IoD, 2013; Kotsakis, 2012; Redacted & Rural Community Policy Unit, 2014). The residents of UK communities may see more standardized costs and benefits from local extraction activity than has been typical in the US. Just as in the US, the brunt of the negative impacts will be borne by the community as a whole; but unlike the US, private landowners and mineral rights owners will not be seeing disproportionate benefits from the industry generated by royalty payments from extraction companies. Landowners may still receive lease payments for the use of their surface land by extraction companies; but they will not be compensated, or even required to consent to, the use of the subsurface beneath their property (Robertson, 2014; White, Fell, Smith, & Keep, 2014). The use of horizontal drilling techniques makes the number of land leases required for substantial drilling operations minimal as operators can construct a 10-well pad on just 2 hectares, or approximately 5 acres, of land (IoD, 2013).

Communities may see some economic benefits from industry activities through community benefit plans, but thus far the majority of these schemes involve payout to the community as a whole and not to individual residents. The process for how these payments will be made is not yet clear as the government and companies have not yet published information on who will receive and distribute the funds.

Cuadrilla has noted that the £100,000 per hydraulically fractured well will be distributed through an “independent community fund,” but the details of this process have not been made clear (Cuadrilla, 2015b). IGas already has a well-developed community engagement scheme in place and has established a Community Fund to assist those communities in which they carry out all activities, not simply shale gas operations. The Fund awards grants through an application process directly to local organizations for proposed community enhancement projects (IGas, 2013). The total amount of funds donated to communities hosting IGas operations in the North West region of England in 2014 amounted to a little over £53,000 (IGas, 2014b). These funds went to support things like the furnishing of community halls, repairing historic buildings, and buying new equipment for playgrounds. This Community Fund and the way it works to distribute monetary benefits to local communities could be an example of what future community schemes proposed by the shale gas industry could look like. Applications for Community Fund grants are reviewed by a panel consisting of both company representatives and local community authorities, and then awards are made to those organizations proposing projects that the panel believes will bring the most substantial and far reaching benefit to the local community (IGas, 2013).

For the purposes of this paper we will assume that the local councils will be responsible at least in part for distributing funds within the community as the distribution of national funding to meet community needs is already a major role of the councils. The current benefit scheme proposed by the UKOOG and the UK government involves a £100,000 payout to the local community per hydraulically

fractured well along with a 1% share of the revenues generated by the well during production (Shale Gas Europe, 2014; Welsh Affairs Committee, 2014). UKOOG estimates that each well site will generate between £5-10 million in revenue shares for communities over a 25-year production period (Welsh Affairs Committee, 2014). On the high side this would equate to about £400,000 per well each year in revenues for local government.

To put this figure into perspective, Lancashire County Council, the local governing body responsible for providing services and approving planning applications for Elswick and a number of other North West towns with shale gas potential, has an annual budget of approximately £730 million. This figure includes the costs for social services, highway maintenance, public health and well being, and many other aspects of community life that stand to see additional costs during a shale industry boom (Lancashire County Council, 2015). Compared to these expenditures, an additional £400,000 is a mere drop in the bucket for local governments. It is unlikely that these added revenues would cover or outweigh the additional costs to local communities for hosting shale gas activity. For struggling communities with little other options for additional revenue, though, the monetary benefits from the development of multiple shale gas wells may be appealing enough to merit planning approval.

In addition to these benefit payments, the national government has recently announced that local governments will be allowed to keep 100% of the business rates on shale gas wells. A business rate is essentially a property tax imposed on businesses, which previously local government only received 50% of (Shale Gas

Europe, 2014; Welsh Affairs Committee, 2014). The Lancashire County Council currently estimates that it will retain around £176 million in business rates per year (Lancashire County Council, 2015). This figure could increase by approximately £1.7 million per gas well annually due to the new business rate retention scheme. This increase in revenues to local government may provide substantial incentive for planning committees to approve of shale gas development within their region (Redacted & Rural Community Policy Unit, 2014; Shale Gas Europe, 2014). The UK government has acknowledged that strains on local services may occur due to growing populations in shale gas communities, but has suggested that this business rate scheme would help offset these additional costs by providing an increase in local funding (Redacted & Rural Community Policy Unit, 2014).

INEOS is presently the only resource extraction company that has proposed paying landowners closer to well sites a higher percentage of monetary benefits than the remainder of the community during commercial production stages. These disproportionate benefits may facilitate the kind of haves v. have-nots social tensions seen in the US, but it is likely to be less pronounced as landowners have little to no say over whether well pads or horizontal wells will be drilled on or beneath their property. Thus those receiving greater monetary benefits could merely be victims of the regulatory and planning procedures governing shale gas development rather than willing facilitators of industry growth. This could create greater community cohesion as those receiving greater payouts due to the extraction activity being carried out on or in close proximity to their property may not necessarily approve of or support the activity.

The social tension seen in the UK will likely be between local communities and the UK government rather than between community factions. This is mainly due to concern by locals over the distributive and procedural justice involved in the development of well sites. Many local activists currently in opposition to shale gas industry growth state that communities lack a fair say in the placement of wells and the extent of mining activity that is to be carried out within their region. I believe that this will be a growing source of contention between local residents and government due to the newly passed 2014 legislation giving extraction companies the right to drill horizontal wells beneath the subsurface of private landowners' property without having to secure permission to drill. I will discuss this issue further in the environmental justice section of this chapter.

Other boom cycle impacts.

The UK is likely to see many of the other community benefits resulting from the growth of the local economy during the boom cycle. Research predicts that there will be substantial growth in the service sectors that support the extraction industry and its operations. This could create a number of short-term, local employment opportunities in trucking, retail, and construction industries (Christopherson and Righthor, 2011). A study commissioned by Cuadrilla Resources and carried out by Regeneris Consulting showed that three test wells in Lancashire could generate a total of twenty-six indirect jobs within the Lancashire region during the commercial production phase. The study also predicts that during the first year of commercial production, the expenditure of extraction industry employees will facilitate the creation of 850 new indirect jobs nation-wide. These employment statistics are

unclear, though, on whether they account for the loss of jobs in other industries due to crowding out by the extraction industry during the boom cycle. This means that these new jobs may simply be replacing the jobs lost in those industries that were driven out of a region by the growth of the extraction industry rather than being additional jobs brought into the region (Redacted & Rural Community Policy Unit, 2014).

During the boom cycle overall employment rates tend to rise along with median incomes, resulting in a decline in the need for traditional social welfare and cash assistance programs (Weber, Geigle, & Barkdull, 2014). This could be a great boon to North West and North East communities where the shale industry currently seems to be centralized as these regions have significantly higher unemployment rates and benefits claimants, and notably low median incomes when compared with the Southern regions of England (IoD, 2013). The development of the shale gas industry could be the kind of economic growth driver needed to put disproportionately impoverished Northern regions on equal footing with the rest of the nation, at least during the boom cycle.

Social Impacts of the Bust Cycle

The boom cycle and its effects are short-lived when compared to the bust cycle and its more long-term impacts (Christopherson & Rightor, 2011). During a bust the community sees many impacts similar to that of a boom, such as social disorganization and increasing crime rates, but they are manifested in different ways. Whereas in a boom social disorganization would largely be caused by rapid

population growth, in a bust disorganization is created by a sudden out-migration of workers, residents, and businesses from the community. This loss of jobs, capital, and services places increased strain on communities and can result in higher poverty rates, lower median incomes, and a decrease in public health for remaining residents (Weber, Geigle, & Barkdull, 2014).

High crime rates have been directly linked to low socio-economic status and increased poverty in communities, making increased crime an indirect result of the bust cycle (Kaylen & Pridemore, 2013; Luthra, Bankston, & Kalich, 2007). The shrinking social networks in the community lead to a loss of informal controls on crime and make it less likely that residents will intervene on each other's behalf to prevent criminal activity. As previously mentioned in chapter 1, studies in the US show that as poverty increases the levels of larceny and assault decrease, but levels of delinquency among minors increases (Kaylen & Pridemore, 2013; Luthra, Bankston, & Kalich, 2007). The strain placed on the community due to changing quality of life and a loss of local jobs and services has also been linked to increases in drug abuse, alcoholism, depression, and anxiety in community residents (Remington, 2013; Shandro et al, 2011; Weber, Geigle, & Barkdull, 2014). The loss of community health and social services due to lack of funding and resources during a bust often exacerbates these health issues as communities are ill equipped to deal with the growing public health problems (Shandro et al, 2011). This is an important consideration for potential shale communities such as Blackpool and Ellesmere Port, which already struggle with a binge-drinking rate above the national average (Collinson, 2013; Strategic Intelligence Team, 2014). These towns are predisposed

to experience negative public health impacts in relation to alcoholism in the case of a boom cycle.

In the UK, the way in which these bust cycle effects present themselves will depend largely on the scale of the boom cycle and how dependent the local communities become on extraction industry operations. The level of social disorganization experienced by a community, which is the necessary catalyst for impacts such as fluctuating crime rates and the degradation of overall community health, is directly dependent upon both the composition of the community and the quality of its population shift (Kaylen & Pridemore, 2013). A community that sees few social impacts from the boom due to slow industry growth rates and low population growth will likely also see minimal impacts from a bust cycle. In addition, a community that retains a substantial amount of non-extraction based industry and depends little on mining operations for employment and growth opportunities will not be as significantly damaged by the loss of the mining industry as a community that is entirely dependent upon extraction operations for employment and support of the local economy. The bust cycle and its impacts are likely to be less significant for UK communities as a whole in comparison to those in the US just as the predictions for the UK boom cycle are also much smaller in scale.

Possible Boom-Bust Impacts on Identified UK Shale Gas Communities

The boom-bust impacts discussed in this chapter will be disproportionate between individual towns and some will likely see greater benefits from a boom cycle or greater damage from a bust cycle than others. For example, the Salford City

region of Manchester has been identified as a possible future host of commercial shale gas production activity. The region has experienced significant, ongoing growth through the success of a number of other major businesses and service industries, such as the communications and financial industries (IN Salford, 2014). The shale industry is not likely to be the main driver of Salford's or Manchester's economy; thus, the community's dependence on the industry for employment opportunities and economic growth is likely to be low. If Salford is able to maintain a diverse economy and low level of dependence on the mining industry, then it will likely be able to avoid any significant devastation from the loss of the mining industry during a bust cycle.

Blackpool, on the other hand, represents a municipality at risk of serious impacts from the boom and bust cycles. A lack of diversity in the economy, present levels of poverty, and the city's close proximity to a large number of exploratory gas wells increase Blackpool's likelihood to develop high dependence on the extraction industry in the case of a shale gas boom. Blackpool would be a prime location for many industry workers to take up residence in order to commute between well sites during production. The current housing crisis noted by local government officials would only be magnified by this influx of migrant extraction industry workers. Many of the poor and those living on fixed incomes within the municipality could be forced out due to a rise in rent prices as adequate housing becomes scarce.

In addition, Blackpool could see a growth in the local service sector as those businesses and industries supporting extraction operations and industry workers expand to meet the demands of the booming shale gas industry. This could promote

economic growth in the region through the creation of short-term, typically part-time jobs and the generation of additional revenues for the locality (Christopherson & Righthor, 2011). Blackpool's employment rates would likely rise, along with its median income level. The number of benefit claimants could potentially drop due to increased economic development and the crowding out of poorer local residents by the population boom (Weber, Geigle, & Barkdull, 2014).

These economic benefits would come with a time stamp, though, as resources will eventually be depleted and the extraction industry will move out. If Blackpool develops a high dependence on the extraction industry, then they will see substantial impacts from the inevitable bust cycle. The out-migration created by the bust could alleviate the housing crisis, but could also lead to an economic crisis as many local businesses would no longer have an adequate customer base to sustain them. Social disruption would again be an issue for the community as it copes with the loss of its 'new normal' as a boomtown and deals with changing population demographics and social dynamics. The fact that bust cycle municipalities are often left in worse condition than they were even before the arrival of the extraction industry means that Blackpool could expect to see even higher crime rates, lower socioeconomic status, and greater health problems than they do currently.

Community health problems are likely to be a significant impact of the bust cycle for Blackpool as it is already labeled as the unhealthiest city in the UK (Collinson, 2013). These are important consideration for the local and nation government to take into consideration when regulating the growth of the shale gas industry in the Blackpool region.

Ellesmere Port also stands to see some substantial social impacts from a shale gas boom. Approximately 37% of Ellesmere Port's population is classified as 'most deprived' on the Index of Multiple Deprivation and approximately 23% are benefits claimants (Strategic Intelligence Team, 2014). These percentages are both well above the nation averages and are among the highest in the region. The economic development characteristic of a shale gas boom could create a much-needed increase in average incomes and decrease the number of benefit claimants in the region as seen in US communities. A population boom, though, could have detrimental effects on the municipality as it currently has a high rate of individuals receiving rent payment assistance from the government and a significant rise in rent prices could displace a substantial number of these local residents (Strategic Intelligence Team, 2014). Ellesmere Port is thus poised to see a loss of social networks in the case of a boom cycle, which can lead to increased crime within the municipality. This is an important consideration for the community as it already sees high rates of vandalism, arson, and shoplifting compared to the nation average. These types of non-violent crimes typically increase in frequency as social disorganization takes its toll on a community.

It is vital that local governments be aware of the potential social impacts specific to their communities when considering shale gas development opportunities within their region. Although there may be numerous benefits to communities, there will inevitably be costs as well; communities need to be aware of both types of activities in order to make informed decisions about accepting shale gas industry activity within their region.

Chapter 8

Conclusion

The US suffered from a lack of information and research conducted on the various costs and risks associated with hydraulic fracturing when the technology first began to be widely utilized in the extraction industry, especially in regards to its effects on the health of people and communities. This is evident in a statement made by the Institute of Medicine at the National Academies of Science, which points out that “Public health was not brought into discussions about shale gas extraction at earlier stages; in consequence, the health system finds itself lacking critical information about environmental and public health impacts of the technologies and unable to address concerns by regulators at the federal and state levels, communities, and workers. . . .” (Steinzor, Subra, & Sumi, 2013). The UK, on the other hand, has a late-mover advantage in the shale gas industry, as it is able to utilize the information garnered through US industry experience without having to repeat its mistakes. Extensive data and research that has been conducted within the last few decades pertaining to the impacts of shale gas development in the US, with growing literature emerging in regards to social impacts and effects on communities. The UK therefore, has much greater knowledge of the risks starting out than was available to the US at the start of its shale gas boom and has the

opportunity to address many of these issues preemptively. If utilized properly, this information may help the UK avoid, or at least minimize, some of the negative effects associated with fracking.

Thus far, the UK seems to be intent on avoiding the kind of environmental harms that have been revealed in the US, such as water contamination and increased seismicity due to fracking. These issues are a major focus of the UK fracking debate and the government has taken various actions to address public concerns over these environmental risks, including the creation of new regulations. The UK boasts of having more stringent regulations for the protection of the environment than those that exist in the US, thus making UK shale gas development more environmentally safe (EAC, 2014; Kotsakis, 2012; The Royal Society & the Royal Academy of Engineers, 2012). For example, after the fracking-induced earthquakes in Blackpool, the government and industry implemented a traffic light monitoring system to mitigate the risks of induced seismicity from drilling procedures (Cotton, Rattle, & Alstine, 2014). In addition, drilling companies in the UK are not allowed to hydraulically fracture beneath underground drinking water aquifers in order to minimize water contamination risks (Kotsakis, 2012). The government and industry have also established best practice guidelines for industry activities, which are promoted as effective means for managing the health, safety, and environmental risks of hydraulic fracturing (Cotton, Rattle, & Alstine, 2014).

As seen in figure 8.1, these increased regulations have been marginally successful in reassuring the public about the safety of extraction practices. It should be noted, though, that these practices are not guaranteed to prevent degradation of

the well sites after production has ended and the wells are simply capped and left to weather the environment. The structural integrity of any well, whether constructed according to best practices or not, will degrade over time as steel corrodes and cement casings crack and disbond. Although they may not be visible from the surface, wells are left in the subsurface indefinitely once extraction activities cease, which leaves open the possibility for leakages of gas and fluids over time (Hays et al, 2015). Current UK guidelines and regulations also focus primarily on environmental and safety issues without addressing the social impacts of industry activity. The current lack of government regulation and safeguards to mitigate any negative social impacts in combination with the void in available literature on the potential social consequences of a UK shale gas industry boom make it appear as if the UK as a whole is generally unprepared to deal with such impacts.

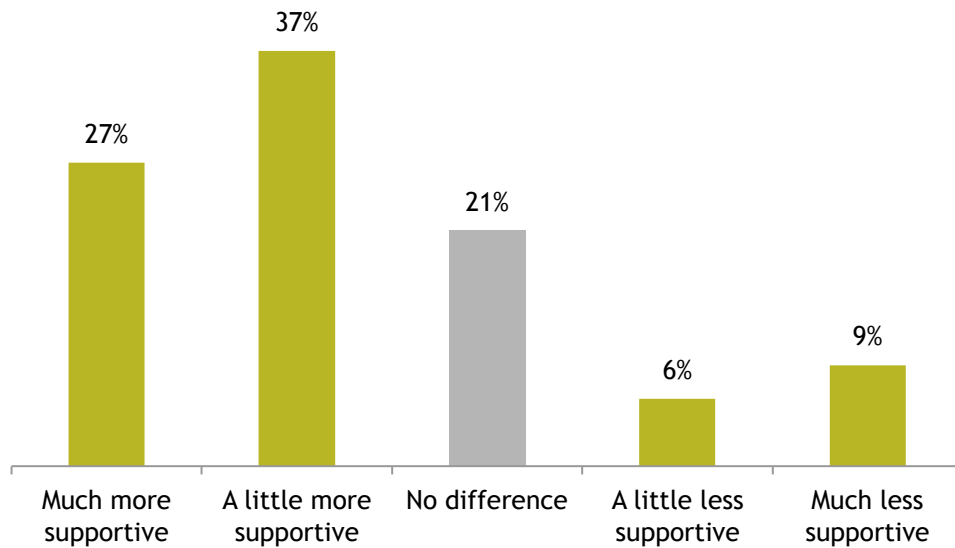


Figure 8.1 UK Public support for shale gas exploration in light of regulation. Survey results when respondents were given a list of regulations imposed by the UK government to mitigate risk of earthquakes induced by hydraulic fracturing and then asked how supportive these regulations made them of continued shale gas exploration in their local area (Britain Thinks, 2012).

This is an issue that needs to be addressed because, as we have seen in this thesis, the growth of the shale gas industry poses to have substantial social impacts on local communities. Although differences in population density, commuter tendencies, property rights and geology may all contribute to variances in the effects of shale gas development in the UK versus the US, there are likely to be many similarities (Hays et al, 2015). The boom cycle is likely to bring substantial economic growth to local communities as the resource industry attracts supporting businesses and increased investments. The boom will also bring notable levels of social disorganization, fluctuation in crime rates, and population increases to UK communities just as it has in the US. In addition, communities will experience increased truck traffic, road deterioration, and noise pollution due to an increase in industry activity during production. During the bust cycle, UK communities may experience the kind of population depletion, deterioration of community health, and

crash of the local economy that has been noted by US communities after extraction activities have ceased. These bust cycle impacts will depend largely on the level of shale gas industry dependence that UK municipalities form during the boom and the ability of these communities to maintain other local industries to support them once the extraction companies move out.

Some differences that may be seen between US and UK social impacts are the lack of social tensions within local communities in the UK due to the absence of mineral rights ownership by private landowners, and possibly less dramatic population shifts for smaller UK communities may occur due to the close proximity of urban hubs and rising commuter tendencies. UK communities will not be uniformly impacted by shale gas development just as US communities see slight variations in the effects of local industry growth. This means that each individual community must be aware of the impacts that pose the greatest benefit or risk to their locality and make an independent decision as to whether they are willing to accept industry activity. In the case of acceptance, each individual community will need to develop its own plan for effectively minimizing any negative impacts and for optimizing any local benefits. Communities also need to be prepared to efficiently handle any economic gains seen through an industry boom cycle in order to best situate themselves to endure the impending bust cycle.

A full description of possible social impacts on local communities needs to be made available to UK residents and local governments so they may adequately weigh the positives and negatives of industry growth and make a fully informed decision as to whether the benefits outweigh the risks to their individual

municipality. Without full disclosure of these risks and benefits, local communities are left ill prepared to deal with both the short and long terms effects that shale gas industry growth may have on their locality. Lack of information and preparation could make these communities more susceptible to experiencing negative social impacts due to the inability to take measures that may mitigate these effects, as well as to the inability of localities to effectively capture the positive benefits brought by industry growth.

As is evident in previous chapters, environmental justice issues also need to be given greater consideration by UK government and as they seek opportunities for shale gas industry growth. Public concern over distributive and procedural unfairness in the siting of wells and the allocation of industry benefits is a major cause of community pushback against industry development. Studies have shown that even if the outcome of siting and allocation procedures is undesirable to stakeholders, they will be more accepting of the outcome if the procedure is perceived to be fair and they believe they have been given adequate opportunities to voice their concerns (Cotton, 2013). This makes it likely that if government and industry can develop greater inclusiveness for communities and residents in their well siting procedures and create a benefits scheme that more adequately and fairly compensates community stakeholders, they may be able to reach the levels of public acceptance needed to jumpstart shale gas industry growth.

These social impacts must be taken into account by both the UK communities making decisions about shale gas industry development in their region and by the national government as they push for greater local support of industry activities.

This thesis may not be able to give a definitive diagnosis of what UK communities will experience in the event of a UK shale gas industry boom, but it is a positive step toward providing the public with greater knowledge of the possible impacts they may see. Communities and local governments in the UK should take advantage of the research available on US boomtown communities in order to predict what effects the growth of industry may have on their own hometowns. Further research on the potential social impacts of a UK shale gas boom is necessary, though, in order to provide communities with a comprehensive base of information on what benefits and risks the industry poses to them. Further research should also be conducted on how local communities can best mitigate negative impacts and effectively plan to take advantage of any growth opportunities created by an industry boom.

Given the current slow growth rate of the shale gas industry in the UK, communities may be able to more effectively plan and prepare for future industry activity if they are provided adequate information about what to expect. Such preparation could aid UK communities in taking greater advantage of industry growth and more effectively mitigating any potential negative impacts it may bring as compared to their US counterparts. In order to do this, though, more studies focusing on the local community impacts of shale gas development need to be conducted and made publicly available to UK residents

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APPENDIX

Maintenance of well integrity in the UK

The UK government has put significant emphasis on following ‘best practice’ guidelines for the construction of oil and gas wells in order to prevent well failure and avoid environmental damage through well leakages (Kotsakis, 2012; The Royal Society & The Royal Academy of Engineers, 2012). A major focus of these guidelines is proper well casing, which entails three layers: the outer conductor casing, the inner surface casing, and the production casing; all of which must be cemented into place (DECC, 2014). An example of what a well would look like under best practice guidelines is shown in figure 9.1. A report by the Royal Society and the Royal Academy of Engineers on hydraulic fracturing in the UK maintains that “the probability of well failure is low for a single well if it is designed, constructed and abandoned according to best practice” (The Royal Society & The Royal Society of Engineers, 2012).

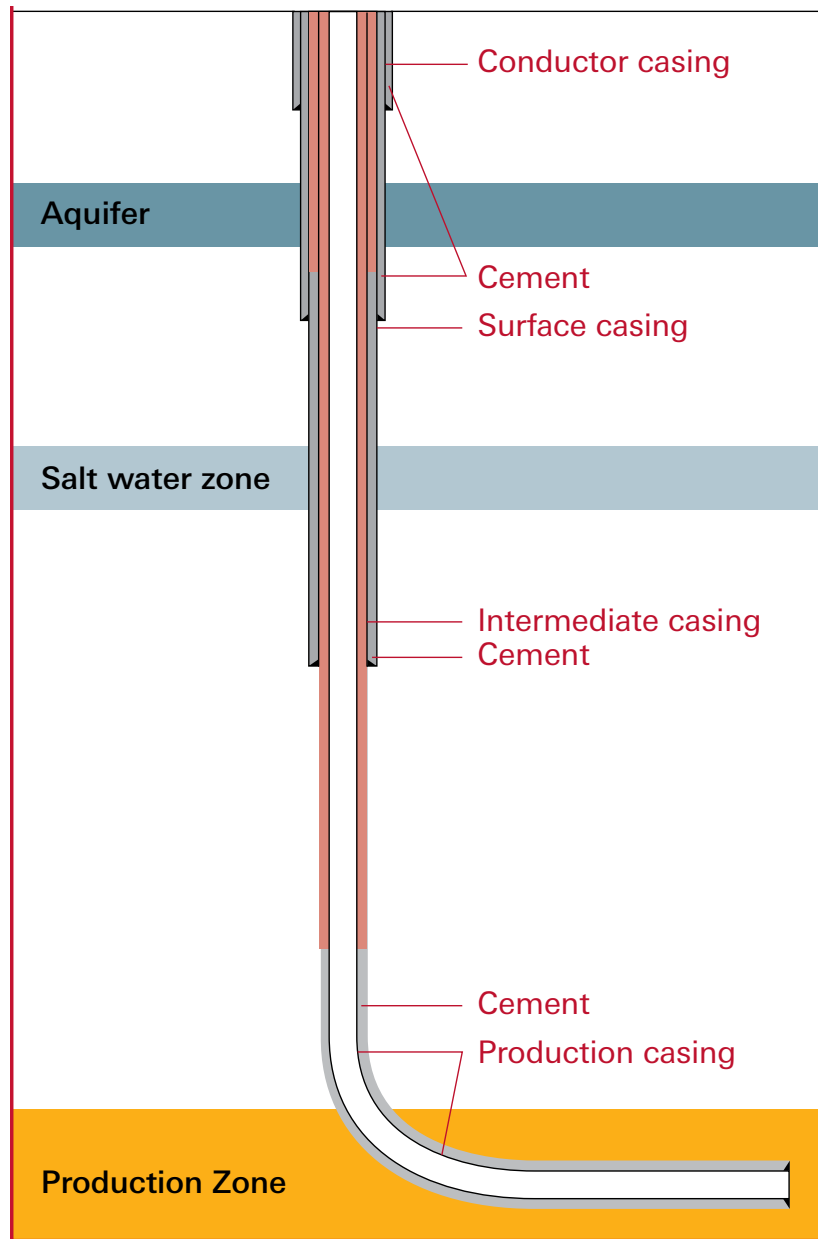


Figure 9.1 Shale gas well structure. Example of a shale gas well as constructed by UK Best Practice guidelines (The Royal Society and Royal Society of Engineers, 2012).